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OUR COMBINED ISSUES.

In spite of efforts made during the past month to catch up with our publication schedule, which the printers' strike had interrupted, the printers have found it physically impossible to do so, the holiday season adding to the difficulty. We therefore decided that the only course possible was to combine issues, publishing each week as many pages as the printers could handle. The four December issues were accordingly combined in one published last week, to finish the volume; and in this issue are combined the first two of the new volume. We hope, following this number, to issue the paper regularly on the publication date.

HOW ABOUT THE 1920 IMPROVEMENTS?

From two months to two years are required for deciding upon and preparing a well-digested and satisfactory plan for any engineering work. At least one or two months are necessary for advertising and letting, and an equal time for the contractor to make his preparations for beginning work. And ground should be broken by April 1st if the job is of any size. This brings us back to December 1st as the latest date for getting started on even a small municipal job.

One month gone already! Have proceedings been begun on all of your next season's improvements?

CONTRACTORS' REPUTATIONS AND AWARDING CONTRACTS.

"Attract to your work strong contracting concerns with ample capital and equipment resource to insure completion of your program. I think we will all admit that the effect would be disastrous if contracts were awarded in large numbers to the contractors without further investigation on our part than to satisfy ourselves that they could furnish a bond. The tearing up of roads and the dragging along of work in a listless manner, on account of financial or other reasons, to the great annoyance and inconvenience of the public, is more than any organization, no matter how well-meaning, could survive. Before work is awarded, the contractor's responsibility should be established through presentation of his financial statements and assurances from banking institutions indicating their willingness to extend him assistance, if need be, to finance the work. This data should also be accompanied by records of his previous performance in contract work."

In the above, referring to state highway work, George H. Biles, assistant state highway commissioner of Pennsylvania, supports the opinion that we have advanced repeatedly for several years past, that in the selection of a contractor for public work more than the figures of his bid should be taken into account. His experience and reputation should be an equally important consideration; for it is essential not only that public work be done, but also that it be done well and without delays and with a minimum of discord.

SOME STANDARD PRACTICES OF WAR-TIME SEWERAGE.

Twenty years ago, when the editor of this paper wrote the first edition of "Sewerage," he included in this and advocated the adoption of several features which at that time were by means common practice, although he did not claim to be the originator of their general principles. Among these were the "rational" method of calculating run-off to storm sewers, the substitution of plain storm-water inlets for catch-basins except under special conditions, and the ventilating of house sewers through the house connections by the omission of running traps. At that time the majority of engineers were, we believe, either actively or passively opposed to these ideas and practices, and illustrations of them in actual municipal practice were few and far between.

It is therefore with considerable gratification that we note that, in the plans prepared by the experts selected by the Federal Government for designing the sewerage of the various camps, cantonments, aviation stations, etc., all employed the rational method of run-off calculation, and the majority, we believe, also included the other two ideas in their general plans.

The rational method of calculating run-off was first given prominence by the late Emil Kuichling, to whom the author of "Sewerage" was indebted for the basis of his discussion of this subject. At the present time there appear to be few engineers or municipal sewer departments which offer any excuse for not using this method except the one that it requires much more figuring than the use of some standard formula, and that the formulas are sufficiently exact for their purpose; which latter statement we beg to question.

In the matter of ventilating through house connections, this is more or less generally opposed by plumbers, but where engineers have interested themselves in the matter we believe they have generally reached the conclusion that it is advisable, and the practice is growing in this country. In England it has for years been the practice to use a contrivance much more elaborate than our running traps and there might perhaps be more argument for its use because of the foulness of the old English sewers; but even there, there have been for some time advocates of the ventilation of sewers through the house connections and during the past year the advocates have increased considerably in number and in persistence.

.In the matter of inlets versus catch-basins there is still far from a consensus of opinion. The reason for this probably is that there are some locations and conditions where catch-basins are undoubtedly desirable, and it is easier in a large city, where most details are standardized as much as possible, to provide catch-basins everywhere than to endeavor to determine for each case whether or not an inlet would not be preferable. On this point we have commented at greater or less length in Municipal Journal from time to time in the past.

In general, we believe that the engineering profession can be congratulated on the planning and construction of the sewerage systems of the various war-time housing projects, including the cantonments. In spite of the urgency and feverish haste with which the plans were prepared and their construction carried out, both plans and construction show few things which the calmer scrutiny of the months following the termination of hostilities can find fault with.

Sub-Contracting Highway Work.

Elsewhere in this issue will be found an article presenting arguments in favor of permitting contractors to sublet portions of their work, special reference being made to highway work. It has for a great many years been the practice of engineers to insert in their contracts a clause forbidding the subletting of the work without the express consent of the party of the first part. There undoubtedly have been in the past unfortunate experiences with sub-contracts and sub-contractors which gave rise to the general inclusion of such a clause, but, as Mr. Hauer says in this article, times have greatly changed and methods should change with them.

Billions of dollars are available for highway work in this country, and the problem for the next few years will be getting the work done rather than paying for it. This can be done by letting many thousands of small contracts or by letting a small percentage of this number of large ones. In spite of any difficulties that may possibly arise through sub-contracting, it would seem almost certain that public authorities letting these contracts will not only secure better work, but also will encounter less difficulty and annoyance, by letting it in a comparatively small number of large contracts rather than the reverse. The large contractor will generally have more complete and adequate equipment for doing first-class work, he will be less likely to be financially incompetent and throw up the work before it is completed, he will generally be found more responsible when it comes to enforcing maintenance clauses or will have a more real consideration for the reputation which he is establishing by the character of the work which he performs, and in many ways the dealings with one large contractor carefully selected will be found more advantageous than with a number of small contractors of all degrees of efficiency and reliability.

This does not necessarily mean, and in all probability would not mean, that small contractors of fair ability would be unable to obtain work. If the contract permits the big contractor to sublet sections of the work, in the majority of cases he will do so, allowing these small contractors to take over the sub-contracts. Nor does this necessarily mean that the sub-contractor would not make as large profits as though he contracted directly with the highway authorities.

There is still another point and one which is too often overlooked. In a great many cases only the bid of the contractor is considered in awarding the contract, and if this is low and the bond is satisfactory, he gets the work. In many cases, however, the contractor has had no previous experience in this kind of work and may be unable, with the best of intentions, to do a good job. Or he may leave both his bondsmen and the party of the first part in the lurch to complete the job, and even though the bondsmen may make good, there is still the annoyance and delay and frequently a loss of unrecoverable expenses which could have been avoided by refusal to give the contract to any but an experienced and reliable contractor. A large contractor is in most cases more competent to determine the qualifications of these smaller contractors than is the party of the first part, with the result that the work is done better and with less friction under the subcontract than it would have been by another small contractor who might have been given the job as a principal.

Altogether, there seem to be so many arguments in favor of permitting sub-contracting on large highway work that we recommend careful consideration of the idea of granting permission to sublet in future contracts.

St. Louis Water Purification Plant Operation

Increased cost of labor and materials raised cost of treatment to $9.10 per million gallons. Nearly nineteen thousand tons of chemicals were used in treating thirty-seven billion gallons, from which 373,321 tons of solids were removed. Taste was removed by use of copper sulphate. Many parts of the plant were corroded by chemicals, and were renewed in some cases with different materials. Pipes and venturi meters were cleaned of deposits.

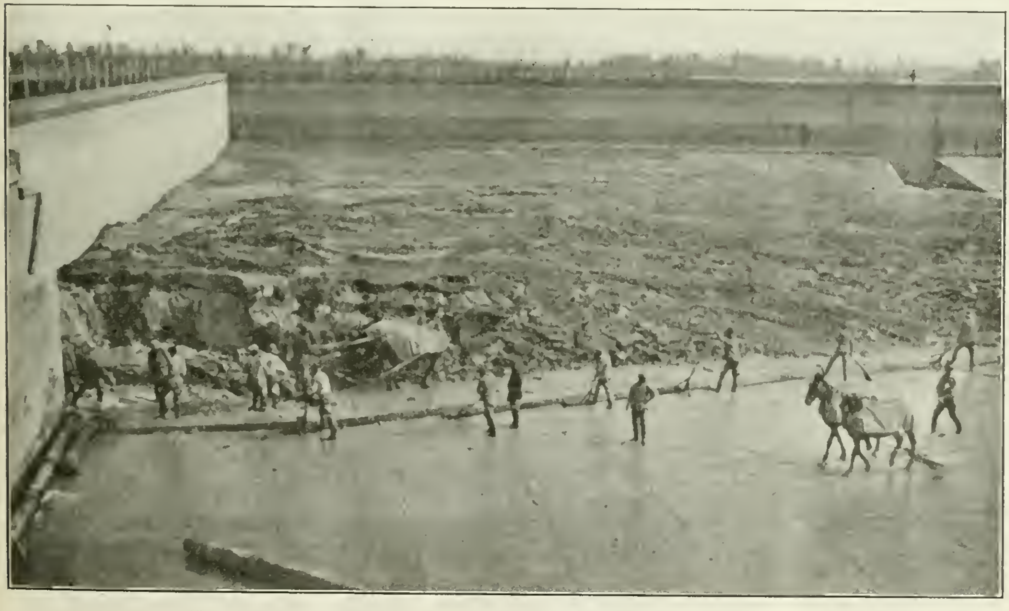
Operating and maintaining the Water Division of St. Louis during the year ending April 1st, 1919, cost $1,650,929, exclusive of the expenditures for additions, improvements and extensions, work done outside the department proper, and war protection. This was $218,108 greater than during the previous year, although the consumption was about four million gallons per day less. There was an increase of $130,615 for salaries and wages, $40,612 for chemicals, and $49,235 for coal.

PURIFICATION COSTS AND RESULTS.

The amount of water pumped into the basins of the purification plant was 37,751 million gallons, and 36,840 was delivered for consumption. In treating this water there were added to it 14,999 tons of lime and 1,781 tons of sulphate of iron in the basins, and 1,790 tons of sulphate of alumina and 83,160 pounds of chlorine at the filtration plant. The average rates of application were 0.66 grain of sulphate of iron, 5.56 grains of lime and 0.66 grain of sulphate of alumina per gallon, and 2.21 pounds of chlorine per million gallons.

The chemicals alone cost $3.72 per million gallons for lime, $0.82 for iron sulphate, $1.37 for sulphate of alumina, and $0.31 for chlorine. The total cost of chemicals at the basins was $4.54 per million gallons, other expenses in connection with this part of purification bringing the total cost to $6.00 Filtration cost $3.10, of which $1.68 was for chemicals. Pumping cost $13.17 a million gallons.

During the year the plant removed from the water 359,323 tons of suspended matter, 13,998 tons of dissolved matter, and 27,290 tons of coagulants precipitated as calcium carbonate, ferric hydroxide and aluminum



CLEANING BASIN NO. 9, ST. LOUIS WATER PURIFICATION PLANT.
Sediment showing a maximum depth of 10 to 12 feet.

hydroxide. Of the suspended matter, 116,456 tons, or 172,530 cubic yards were removed by the grit chamber, or 32 per cent of that present in the river water. Over half of this was fine enough to pass a 100-mesh sieve.

All of this deposit was flushed back into the river. The periods between cleanings of the grit chamber varied from 4 to 14 days. Of the other suspended matter, collected in the basins, about 127,000 tons was removed by laborers and teams and the remainder was flushed out through the sewer by opening the mud gates about 6 inches for a half-hour period at varying intervals. The removal by teams from the five basins cost $2,847.67, or 1.5 cents per cubic yard.

Averaging the results for the year, the hardness was reduced from 183 in the river to 101 in the mains. The total bacteria on gelatin averaged 43,500 in the river, 1,160 after settling, 830 as applied to the filters, and 200 after filtration; the corresponding figures on agar being 9,160, 75, 46, 12, and 9. The number of B. Coli per c.c. averaged 37 in the river, 0.51 after settling, 0.36 as applied to the filters, 0.048 after filtration, and 0.01 on entering the mains.

TASTE IN THE WATER.

As usual, there was trouble with organisms in the Compton Hill reservoir. The circulation of the water is limited to a small part of the basins, which causes "dead" spots in which the organisms collect and thrive.

The south basin at Compton Hill was treated three times with copper sulphate during the summer and was emptied and cleaned once. The north basin was treated twice with copper sulphate. The organisms reached a maximum of 2,000 per cubic centimeter in September. Diatoms were the organisms found in greatest number. The crustacea, moina and cyclops were the principal macroscopic organisms found.

Complaints of bad taste were received at two times during the year. In June complaints of a grassy or fishy taste were received. Most of these complaints were from people who were being supplied water from Compton Hill. At that time there were 1,400 organisms per cubic centimeter in the Compton Hill water. The basins were treated with 0.52 part per million of copper sulphate and the number of organisms dropped to 150 per cubic centimeter and no more complaints were received.

On November 30th the taste of the water was variously described as "ammonia, carbolic acid or medicine" by the people making the complaints. The taste was due to the action of chlorine upon the organic matter present in the water at that time, but was not due to the excessive use of chlorine or to the presence of free chlorine in the water.

SUMMARY OF OPERATION.

During the year 37,675 million gallons of water were filtered at a cost of $3.10 per million gallons. The forty filters were continually in service, except for short periods of time when minor repairs were being made. The rate of filtration during the year varied from a maximum of 124.44 million gallons per acre per day to a minimum of 31.11, averaging 80.57 million gallons per acre per day. The maximum run of a filter was 225 hours, filtering 23.58 million gallons; the minimum run was 16.90 hours, filtering 1.97 million gallons, and the average run was 59.8 hours, filtering 6.46 million gallons.

The forty filters were washed a total of 5,828 times, using 498 million gallons of water, or 1.32 per cent of the water filtered.

During the year 1,790 tons of aluminum sulphate have been used. Of this amount 1,749 tons were added to the settled water and 41 tons to the applied water at the influent pipe to each filter after washing. None was used at the influent flume at the north or south ends of the filter plant. The charge of aluminum sulphate to the settled water has varied from a maximum of 2.12 grains per gallon to a minimum of 0.23 grains, the average being 0.65 grains per gallon of water filtered.

A total of 83,160 pounds of chlorine has been added to the filtered water, the maximum charge being 4 pounds per million gallons, the minimum 0 and the average 2.208 pounds per million gallons of water filtered.

In order to obtain information on the increased coating of the sand grains during the past two years a vertical section of the sand bed was collected from one of the filters after washing and divided into horizontal layers. Treatment of each layer with hydrochloric acid was followed by a thorough washing with water. The per cent loss due to the acid treatment varied from 14 in the top inch to 3.3 at 22 inches from the surface. Two years ago the losses at the same depths were 9.8 per cent and 1.13 per cent respectively.

CORROSION FROM CHEMICALS.

August V. Graf, the chief chemist, reported: "The north lime line is in bad condition. The south line has been taken up, cleaned and relaid on a gradual upward slope from the coagulant house to the mixing chamber. The line will be cleaned at frequent intervals by forcing a mechanical cleaner through the pipe. This line was cemented at the joints and it is expected will develop fewer leaks than the old line, which was leaded at the joints."

Corrosion by chemicals has been found troublesome in many parts of the purification plant. August G. Nolte, superintendent of the filter plant, gives the following description of these troubles and the remedies applied:

"The concrete sulphate dissolving boxes in the chemical room have again been resurfaced with cement mortar and coated with asphalt. The copper screens in the dissolving boxes are rapidly deteriorating and are not worth repairing so they are being replaced with boards drilled full of holes; these answer every purpose of the screens and are easily removed.

"The surface of the bottom of the solution tanks is becoming more and more raveled so that it will probably be advisable to resurface the bottom of all the tanks during the coming year. The sides are still intact.

"The agitator shafts in solution tanks Nos. 1 and 2 have been renewed during the year. There is still one tank, No. 4, that has the original shaft in it; this, however, will have to be replaced shortly.

"Many of the 3-inch gate valves around the chemical pumps and solution tanks are again leaking slightly. They were repaired about a year ago. This leakage causes no waste but makes handling the solution a little inconvenient. A blank lead flange has been inserted beyond each sewer valve from the solution tanks so as to insure no waste from that source. As it is only necessary to flush the tanks about once every two months, the removal of the blank flanges does not consume much time.

"Bronze gate valves, around the aluminum sulphate solution, operated as frequently as they are, will not hold up for any length of time. Any attempt to keep them leak proof would mean constant repairing. So as long as their leaking does not interfere with the proper application of the sulphate solution and does not cause any waste of solution it is better to tolerate a little leak rather than make constant repairs.

"The vertical agitator motors in the chemical room have been taken apart and the parts bathed in gasoline.

These motors are subject to much dust and so canvas hoods have been made to protect them.

"The 4-inch lead solution lines through which the aluminum sulphate solution is conveyed to the point of application has been cleaned several times. Instead of pulling a 4-inch leather disc through as was formerly done and which meant disconnecting a line about every 60 feet, we now use a double rubber disc and shoot it through with water pressure. This only necessitates disconnecting an entire line, about 800 feet in length, at two places. The disc will pass around bends of 3-foot radius and through the 4-inch open gate valves on the line. The water pressure required to shoot the disc has averaged from 20 to 50 pounds per square inch. No bulging whatever has resulted from this pressure. With this disc the work of cleaning is done much more thoroughly than by hand, in about one-third the time, and is really a protection to the pipe since it eliminates disconnecting and thereby preserving the peaned gaskets.

"The 1¼-inch brass cocks on the 1¼-inch lead solution line to the influent of each filter have been reground several times during the year. When these need replacement globe valves should be substituted.

"The bronze orifice castings in the orifice boxes of the automatic chemical meters and the conical plugs that regulate the area of the outlet have had to be repaired on account of the corrosive action of the sulphate on these parts. The bronze orifice casting was turned out about ¾ inch and an orifice bushing made that would screw into the casting so that hereafter the bushing, when deteriorated, may easily be replaced. The plugs were turned down and polished. Since these repairs were made the automatic control properly regulates the amount of solution to be fed in proportion to the amount of water passing through the 8-foot meters.

"Last July the three 4-inch venturi meters at the north end of the plant used for measuring the amount of aluminum sulphate applied to the settled water were taken apart and cleaned. The meters were so badly clogged with scale from the alum solution that the diameter at the head was reduced from 4 inches to 3 inches and at the throat from 1⅝ to 1⅜ inches. Before cleaning, the meters recorded and indicated about 30 per cent too fast. After cleaning the variation was only 1 per cent. We have made it a practice now to leave the meters disconnected when not in service because we have found that solution standing quietly in a meter deposits scale much more rapidly than when in motion.

"The 4-inch tile pipe chlorine line laid as an experiment to convey the chlorinated water to the drawing conduit chamber had to be abandoned on May 20, 1918, on account of the excessive leakage from it. There was some leakage at the litharge joints but the greatest leakage occurred through the body of the pipe itself."

Sub-Contracts on Road Construction*

By Daniel J. Hauer.

The author presents arguments in favor of letting road work in large contracts, and permitting the contractor to sublet whatever he may wish, holding him responsible for results.

Under the caption, "Two Cooks or One?" A. N. Johnson in the September issue of Successful Methods opens up an interesting discussion of letting contracts for highway improvement. No one is better fitted than Mr. Johnson to speak for engineers upon any highway problem, but naturally he approaches the subject from an engineer's viewpoint and he gives a symposium from the leading highway engineers of the country, that must have entailed much labor to obtain. His deductions and recommendations are along good practice, but it seems well to present the contractor's viewpoint and to call attention to some of the inconsistencies that are to be found in the views of some of the engineers quoted, and especially in the construction specifications of a great number of state highway departments.

Mr. Johnson points out the need of attracting the well-established contractors to the highway field. This is advisable, but one evil in letting contracts should first be eliminated, namely the small contract. One reason in the past for small contracts has been the desire to have some road improvements made in every village and district. As a result in nearly every county and state there are many short sections of improved roads fast going to pieces.

LET LARGE CONTRACTS.

To build a mile of road a contractor must have some type of excavating machine, horses and wagons, a fleet of motor trucks, rollers, concrete mixers, levelers, drags, finishing machines, unloading apparatus, possibly crushers and sand and gravel washers, perhaps an asphalt plant, and many other tools and appliances. Without an ample modern plant he cannot hope to obtain contracts or

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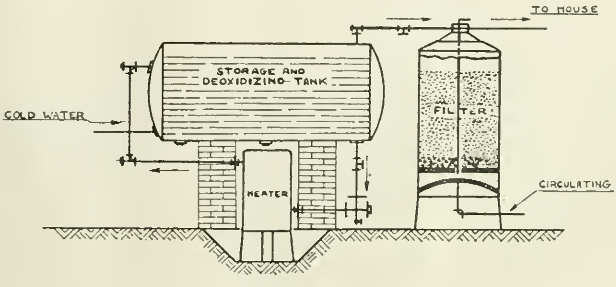
*From "Successful Methods" for December, 1919.

Prevention and Cure of "Red Water."

Under this title we published an article in the issue of November 22 describing a process for deoxidizing water with that end in view. This illustration of the apparatus should have accompanied the article, but the drawing was not received in time.



SKETCH OF DEOXIDIZING SYSTEM

do them economically. The same plant that may be employed for a few weeks or months on a short contract will build ten miles or more of road in a season. To put it in other words, a contract for $20,000 worth of road construction may require $30,000 worth of plant, although the value of the plant may not have to be increased more than ten or fifteen per cent to do a $250,000 contract.

Occasionally a short or small contract may be necessary, but with millions to expend and hundreds of miles to build, contracts should be of such size as to assure economical construction.

PROHIBITING SUB-LETTING.

A contractor undertaking a large contract will wish to complete it both quickly and economically. In some cases this means placing his own forces and equipment upon the job and doing other parts by means of subcontractors. Immediately he is confronted by a provision of the specifications reading as follows:

> The contractor shall not sublet, sell, transfer, assign or otherwise dispose of the contract or any portion thereof or of the work provided for therein, to any person or corporation without the written consent of the state highway engineer.

This certainly is drastic, for such written consent is seldom obtained. Contrast this with a provision taken from a set of railroad specifications.

> Subletting of any part of the work under this contract can be done by and with the approval of the chief engineer.

They do not seem dissimilar, but one clause is meant to prevent subcontracting, the other to encourage it, as the writer has learned from experience.

One engineer wrote to Mr. Johnson, "What I believe would be productive of the best results would be to specify that the grading and drainage work could be sublet to other contractors and to encourage rather than discourage, as is done at present, the matter of subletting a portion of the work."

In spite of this opinion, this engineer's specification, revised only last year, contains a clause regarding subletting very similar to the one quoted. He has also inserted in his revised specifications this clause:

> At no time during the prosecution of the work shall more than four blocks or squares, or in open country more than one-half mile of roadway, be under construction or obstructed to traffic without permission. The laying of the surface course or pavement shall follow the completion of the base course as closely as may be required by the engineer.

Another engineer limits the grading work to at least a quarter of a mile from laying of the pavement, while still another specifies that the subgrade must be finished for at least 200 feet ahead of the pavement, but does not limit the distance it can be carried ahead, yet the writer is told that the highway commission controls the situation by curtailing the monthly estimates on grading done a few thousand feet ahead of the pavement.

It is well enough for engineers to theorize and make suggestions and give their opinion as to successful methods, but practice is the essential, and one step ahead is to change contract forms and specifications so as to obtain economical results. Railroad companies and other private corporations have used and developed subcontracting to their own benefit, and it is time for our road engineers and commissions to learn from others.

MODERN SPECIFICATIONS FOR MODERN CONDITIONS.

The next step after increasing the size of the contract is to allow the successful contractor to use his discretion in subletting the work. This means that engineers must make their specifications modern and considerably more business-like than at present.

With these two things accomplished, contractors themselves will solve the problems. Regrading and resurfacing jobs, when the excavation is slight, would no doubt be done by the paving contractor. To limit the amount of road that can be torn up at one time for this class of work is not unreasonable, but no limit should be set for new road work, cut-offs, new alignments or heavy mountain roads.

Should engineers and road commissions desire to let the grading separately so as to have it done a season ahead of the paving, they can make the excavation and drainage one contract, to be followed later by a paving contract, or the entire work can be let at one time and the successful contractors either can sublet the grading, or, if they wish to do this part themselves, can sublet the paving·

Another method is to write bids on the combined work or on each class of work separately. As this is being written, a county in a southern state having $2,000,000 to expend, is inviting bids on grading and paving, on grading alone, on culverts and bridge work alone, and on paving alone. A request also is made for bids on a minimum of three miles of highway with the privilege of taking as many additional miles as a contractor feels he can handle. This method, brought forth by a desire to contract for the road construction under satisfactory prices and conditions, should attract bids at reasonable prices.

The solution of the problem is to let large contracts with the right to sublet. Then the contractor with strong financial backing and a large organization with ample equipment, will make use of the smaller contractor in whatever place he sees fit. He may let the grading to one subcontractor and to others the culverts and bridges and possibly some of the paving.

The answer in most case would be "one cook" who would make bond, have ample capital, and through his own organization and that of his subcontractors would control large forces of skilled workmen and plenty of machinery. Even with half a dozen contractors, the management of the work would be under one man, which would avoid delays and the conflicts that may arise between different contractors on the same work.

WORK FOR BOTH SMALL CONTRACTORS AND LARGE CONTRACTING ORGANIZATIONS.

Many contractors, who may not have cash to put up certified checks for bidding or who would have difficulty in obtaining bond for a large job and yet have sufficient capital and plant and possess the experience and skill to do first-class work, can be used by the general contractor as subs. With their own money and plant at stake they will do the work cheaper and better than it is likely to be done by a superintendent of the general contractor.

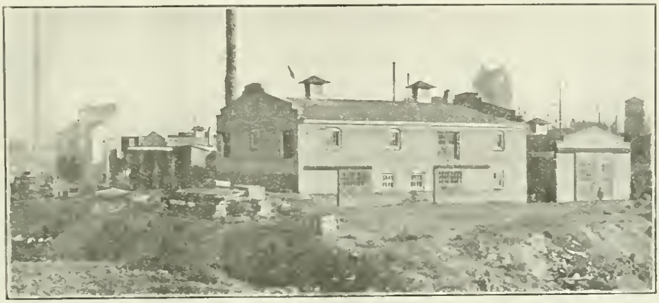
This method will make available large contracting organizations throughout the country, as well as hosts of local contractors, equipped to do grading, masonry, paving, clearing, fencing and other classes of construction.

The experience of the past in road building should not be the criterion for the present or future. Conditions have changed, the public voting vast sums and demanding that roads be built quickly and cheaply with this public money. Commissioners and engineers must understand these changed conditions and meet the problems. The methods of the past must go·

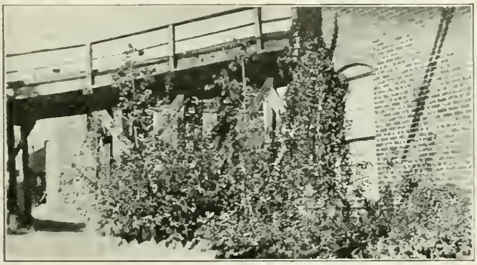
Landscape Gardening at Spokane Incinerator

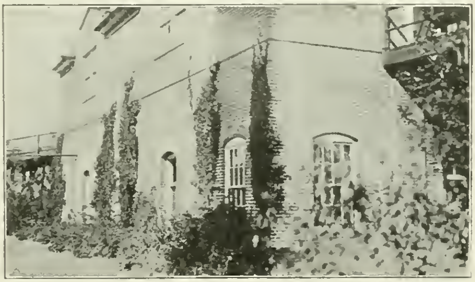
Under the title "A Garbage Crematory with Self-respect," Arthur E. Peterson, superintendent of the Crematory Division of the Department of Public Works of Spokane, described in our issue of March 15th, 1919, the improvements planned for giving an attractive appearance to the buildings and grounds of the municipal crematory. Planting of shrubbery was begun a year ago last spring, and the great improvement already made is indicated (but not fully brought out, we believe) by the accompanying photographs taken last summer.

THE ILLUSTRATION AT THE RIGHT SHOWS A VIEW OF THE PLANT IN MARCH, 1918, TAKEN FROM THE UPPER LEFT-HAND CORNER OF THE SKETCH OF THE GROUNDS SHOWN BELOW, THE STABLE BEING IN THE CENTER, THE CREMATORY BUILDING AT THE EXTREME LEFT.

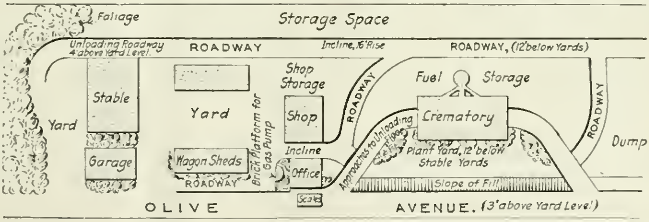


THE LEFT-HAND PHOTOGRAPH, SECOND LINE, SHOWS THE USE OF SHRUBBERY FOR SCREENING THE APPROACH TO THE UNLOADING FLOOR. THIS IS THE LEFT-HAND FRONT CORNER OF THE CREMATORY. THE RIGHT-HAND PHOTOGRAPH SHOWS THE RIGHT-HAND CORNER OF THAT BUILDING.

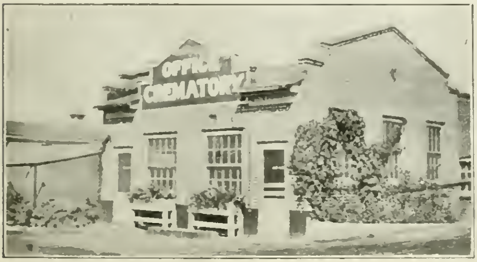


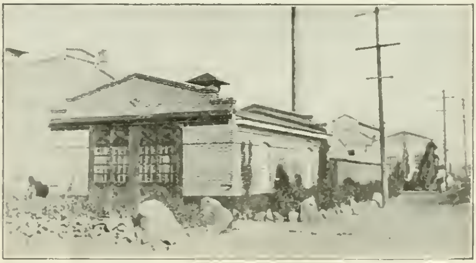


THE SKETCH AT THE RIGHT SHOWS THE PLAN FOR GRADING AND PLANTING, REPRODUCED FROM THE MARCH 15TH ISSUE. BELOW IS SHOWN THE OFFICE BUILDING AND AN END OF ONE OF THE WAGON SHEDS.


Foliage
Storage Space
Unloading Roadway 4' above Yard Level.
ROADWAY
Incline, 16' Rise
ROADWAY, (12' below Yards)
Stable
Yard
Yard
Shop Storage
Shop
ROADWAY
Fuel
Storage
Crematory
ROADWAY
Dump.
Brick Platform for Gas Pump
Incline
Approaches to Unloading Floor
Plant Yard, 12' below Stable Yards
Garage
Wagon Sheds
Office
ROADWAY
Slope of Fill
Scale
OLIVE
AVENUE. (3' above Yard Level)

THE PHOTOGRAPH BELOW SHOWS THE GARAGE IN THE CENTER, THE STABLE AT THE LEFT, AND AT THE RIGHT THE FRONT OF THE BUILDINGS FACING OLIVE AVENUE, WITH THE CREMATORY AND ITS CHIMNEY IN THE CENTER BACKGROUND.





Disappearance of Floc in Filtration Plants*

By Charles H. Capen, Jr. †

In the Bridgeton, N. J., plant, under certain conditions the aluminum floc failed to form. It was found that the formation of floc could be secured by agitating the water by means of air.

The city of Bridgeton, New Jersey, which has a present population of 15,000 people, has possessed a municipal water works since the year 1873. Changes have been made at various times, both in respect to the source of supply and the buildings and equipment, and in 1911 plans were submitted to the department for a modern filtration plant. These plans were approved and the plant was completed in 1913. The daily water consumption is about 2,000,000 gallons.

The plant is located on the west bank of Cohansey creek, just northwest of the main center of the city. The original intake is situated on what is known as the "Raceway," at a point about one-half mile above the plant. This water course has been dammed up, giving access for boats and canoes to reach Tumbling Dam pond. The number of people using the latter for bathing purposes increased so rapidly that, in order to obtain water containing a smaller amount of polluting material, the intake pipe line was extended from the original intake to a point near the mouth of the stream, known as Northwest Passage, a tributary to the pond. The water is now drawn from the passage during the greater part of the year. At times of heavy rains, however, the original intake is used so as to take advantage of the extensive settling period provided by the pond, thus eliminating to a certain extent the necessity of treating a highly colored and turbid water.

At certain times, in spite of all precautions, the chemical and physical charactersitics of the water are subject to sudden changes, particularly after heavy rain storms; and the color, which is always fairly high, increases, while the alkalinity, which is always low, decreases. The turbidity usually increases. When such conditions arise the disappearance of the "floc" usually follows.

CAUSE OF FLOC DISAPPEARANCE.

Experiments have been conducted by members of this department at various times and by W. Dayton Frederick, commissioner of public works of Bridgeton, who has charge of the plant, to determine the cause of the floc disappearance, and to find a remedy. The conclusion was that the water received an insufficient amount of agitation after the addition of the chemicals.

The water enters a small gate house from the 36-inch gravity influent main, and then passes through a large channel directly into the coagulation basin, and after passing through the latter goes through a pipe line onto the top of the filters. The chemicals are added in the gate house at a point just in front of the channel. Under these conditions no agitation is provided and the mixture of the chemical solutions with the incoming water is very incomplete.

The coagulation basin has a capacity of about 140,000 gallons. The detention period is 1 hour and 40 minutes, and the average distance traveled by the water while passing through the tank is about 115 feet; so the velocity would be 0.0192 feet per second. Practically no finely divided suspended material will settle out at such a relatively high velocity without the action of a well formed floc. Up to the time of the solution of the problem, as explained later, the presence of a floc in the basin could often be observed in a sample collected below the surface, but was seldom discernible in samples collected at the surface. Under normal conditions, however, a good floc was usually visible on the top of the filters. It is necessary to have a residual floc in the water on top of the filters in order to form a mat that will assist the filters in removing the suspended material that is not taken out in the basin. When the floc disappears, a considerable portion of this solid material, in addition to a great deal of coloring matter and possibly a certain amount of free alum, passes directly through the filters.

Under normal conditions it is necessary to add soda-ash to the water to provide a sufficient amount of alkaline material to react with the alum. Whenever the abnormal conditions have occurred it has been found necessary to greatly increase the amount of soda-ash. Subsequently the alum has usually been increased but the ratio of soda-ash to alum has nearly always been kept far above normal; i. e., the normal ratio has been about 0.5 to 0.6 grain per gallon of soda-ash to each grain per gallon of alum, but the ratio at such unusual times as mentioned has been 0.8 to 1.0 grain of soda-ash to each grain of alum. In fact, a great range of ratios has been tried on each occasion and the one which apparently gave the best results at that time was finally used. Nevertheless the floc would continue to disappear and reappear at unexpected intervals for periods varying from 1 to 3 or 4 days until the water had again reached its normal state.

During a recent critical period it was observed that no floc could be found at any point in the basin while a noticeable floc was found on top of the filters. Upon going over the situation it was decided that the formation of this floc must have been due to the agitation of the water in flowing out of the basin, through the pipe, and onto the filters. Accordingly, samples of treated water were taken from the basin and some were allowed to stand while others were violently agitated for one or two minutes. After five minutes the former remained unchanged in appearance while the latter showed the presence of a heavy floc. At the end of one-half hour the floc in the latter had practically all settled out. Of course this condition was ideal, due to the method of stirring. In a basin, due to the velocity of flow, the floc would necessarily require a much greater period of time to settle out.

From the above experimental evidence the obvious conclusion was that the failure of the floc to appear in the basin was due to the lack of thorough mixing of the chemicals with the water. The commissioner was notified to this effect. After considering various methods that could be used to produce the desired effect, including baffling and mechanical agitation, it was decided that agitation should be provided by passing compressed air throuh the water at a point near the entrance to the coagulation basin. For this purpose an air compressor, at one time used in connection with the air-wash for the filters, was put into service by laying a 2-inch pipe line from it to the basin. This line was carried across to the middle of a concrete beam over the basin nearest the point of entrance; i. e., about 14 feet from the entrance. The pipe was then carried vertically down to a point several feet below the surface of the water and connected at that point to a horizontal cross-piece of perforated pipe extending across the basin perpendicular to the line of flow. The air compressor was then started, resulting in violent agitation of the water as it passed over the cross-piece. The appearance of a heavy floc in the water immediately followed. The floc appeared heaviest at a point about 15 feet beyond the cross-piece and its slow settling action could be clearly followed during its entire course through the basin.

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* From "Public Health News," published by the New Jersey Department of Health.

† Assistant sanitary engineer, State Department of Health of New Jersey.

Since the installation of the agitating device, the water has already passed through one of the critical periods and no diminution in the quality of the floc took place during that time. It was, however, necessary to slightly increase the amount of chemicals in order to remove the increased color and solids satisfactorily. It is evident that a much larger percentum of the coloring and solid matter could be removed in the basin if the detention period was much greater, or the velocity much smaller.

Sewering War-Time Housing Developments

Details of designing and constructing sewerage and sewage treatment plants for the U. S. Shipping Board, the Department of Military Aeronautics, and others. Rainfall curves, run-off co-efficients, designing storm and house sewers; use of machinery in trenching; pipe laying, constructing manholes, etc. Sewage treatment; simple sedimentation tanks used generally for housing developments; Imhoff and septic tanks at aviation fields. Disinfecting effluents.

Among the papers read before the American Society for Municipal Improvements was one describing the drainage, sewerage and sewage treatment methods employed in the various emergency housing developments in connection with ship construction during the war, by C. P. Collins, engineer of sewerage and drainage for the U. S. Shipping Board; and one describing the industrial housing development of Loveland Farms, near Youngstown, O., by Morris Knowles, John M. Rice and A. O. Rose. Each of these describes at some length the sewerage methods employed, in which there were a number of points of interest.

DESIGNING STORM SEWERS.

Taking up first the standard methods developed for the emergency housing projects, it is stated that the run-off provided for by the storm sewers was calculated by the rational method. Although this method was advocated some twenty-five years ago by the late Emil Kuichling and was described at length by the editor of this journal twenty years ago in the first edition of "Sewerage" and recommended for use in preference to the simpler formulas, it has only slowly come into general use, although a considerable percentage of the cities now use it as the basis for their storm-sewer calculations.

In the work of the Emergency Fleet Corporation's housing projects, certain co-efficients of run-off (that is, percentages of the rain-fall which reach the sewer) were adopted as follows: For roofs, 100 per cent if directly connected with the sewers and 90 per cent if directly connected with the gutters. For pavements, 90 per cent if of asphalt, concrete and other dense pavements, brick, stone block, etc., with close joints; and 60 per cent if of blocks with wide joints. For roadways, 40 per cent for macadam, 30 per cent for gravel, and 25 per cent for hard earth. For sidewalks, 90 per cent for those extending to gutters and 60 per cent for those separated from the gutters by parking. For lawns, parking and open spaces, 20 to 35 per cent. For meadows and cultivated areas, with various slopes and surface conditions, 1 to 20 per cent.

In selecting the heaviest rain-fall for which the sewers should be provided, so-called "design-curves" were employed, based on formulas for the several localities. For the vicinity of Philadelphia this curve was represented by the formula $\frac{12{\cdot}5}{\sqrt{t}}$. For Baltimore, $\frac{120}{t+20}$. For New England, there was used the Boston curve from the United States Weather Bureau records, which is $\frac{15.5}{\sqrt{t}}$. For the middle west the published curve of Chicago, also based on the U. S. Weather Bureau records, was $\frac{120}{t+27}$. For developments in the South the published curve of Savannah, Ga., from the records of the same bureau, was represented by $\frac{163}{t+27}$.

In designing the grades and sizes of storm sewers, a velocity of three feet per second was adopted by the engineering branch as the minimum velocity, and 12 inches as the smallest diameter for any sewer receiving rain water. The velocities and capacities were calculated by use of the Kutter formula, using a co-efficient of roughness of .013 for vitrified pipe and .015 for pipe of concrete and similar materials; vitrified pipe being used for sizes up to and including 24-inch and concrete for larger sizes.

In the case of the Loveland Farms the rainfall provided for was determined by data collected in the Pittsburgh district, and inasmuch as Pittsburgh lies in the path of all storms following the Ohio Valley, while Youngstown is located on the outskirt of that drainage basin, the use of the Pittsburgh data would seem to be perfectly safe. The curve for ordinary storms was used, since it was believed that the possible damage and inconvenience occasioned by rare storms of greater intensity would be more than balanced by the saving in first cost and annual charges secured by building the smaller sewer.

In determining the average rain-fall co-efficient, a study was made of a typical block which indicated that the streets, roofs and walks occupied 30 per cent of the entire area, driveways 9 per cent, and grass plots and gardens the remaining 61 per cent. It was assumed that a co-efficient of 90 per cent would apply to the streets, roofs and walks, 30 to the driveways, and 15 to the grass plots and gardens; this giving an average run-off co-efficient for the entire area of 0.4. On account of the slope of the ground, it was estimated that the time of concentration of flow at inlets would be eight minutes. In both this and the emergency housing designs, the time of flow in the storm sewers was calculated from the slopes and size of the sewers. In this case also the sewer flow was calculated from Cutter's formula with a value for n of .013 for vitrified pipe and .015 for concrete.

Where property fronted on a storm sewer, roof-water connections were made to these for each house. Where there were no storm sewers, the roof water was removed by connecting the roof-water leaders with a small lateral running along the curb line and discharging into an inlet. This lateral, however, was entirely separate from the usual curb underdrain and was laid with cement joints. In certain sections near the upper ends of the sanitary sewer laterals a limited number of roof-water drains were connected to the house sewers, both to assist in flushing the upper ends of such sewers and to avoid inconvenient connections to the storm sewers.

In the emergency housing projects, storm sewers were laid at the minimum depth which would give sufficient cover to protect the pipe; this cover varying with local conditions but being in no case less than two feet.

Local conditions, such as existing grades and kind of pavement, largely fixed the spacing of the manholes, but 400 feet was considered a maximum interval between them for storm sewers.

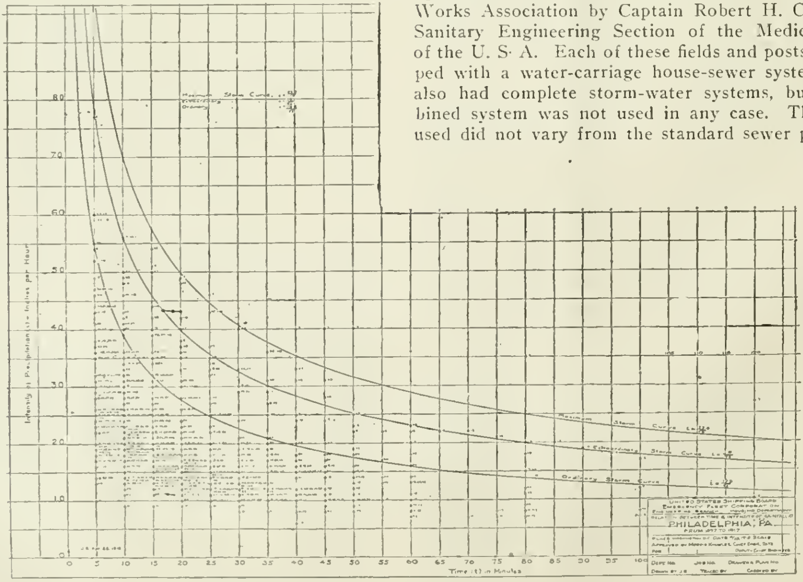
As a rule, catch basins were not used, although a few were employed in special instances. Inlets were considered preferable to catch basins for most of the developments, as catch basins are largely a source of nuisance and greatly increase the cost of maintenance.

DESIGNING HOUSE SEWERS.

In general the separate system was preferred to the combined, although the latter was approved for developments at Portsmouth, N. H., Newburgh, N. Y. and Wilmington, Dela., for the reason that the combined system had already been adopted by the municipal authorities of these places and the developments could be most economically served by extending the existing systems. The separate system was adopted for the other developments, 17 in number.

In designing the house sewers for these projects, the engineering branch generally allowed for an average flow of 90 gallons per capita per day, with a maximum flow in laterals of four times the average and in mains of 2¾ times the average. The grades were required to be such as would theoretically produce a velocity of two feet per second when the sewer is running full or half full. This required a minimum grade of 0.42 per cent for 8-inch, 0.30 per cent for 10-inch and so on up to 0.08 per cent for 24-inch. At dead ends and summits, however, a grade of one per cent was required for 8-inch sewers or else a special arrangement for flushing was provided.

Still another set of government projects provided with sewerage were the aviation fields and posts, there having been established 32 regular flying fields and several smaller temporary fields and three balloon schools, together with a number of supply and repair depots and miscellaneous posts. A brief description of the sewerage of these was given before the American Water Works Association by Captain Robert H. Craig, of the Sanitary Engineering Section of the Medical Division of the U. S. A. Each of these fields and posts was equipped with a water-carriage house-sewer system. Several also had complete storm-water systems, but the combined system was not used in any case. The materials used did not vary from the standard sewer practice.



"DESIGN CURVE" FOR PHILADELPHIA DISTRICT AND DATA FROM WHICH IT WAS CALCULATED.

The grease contents of the sewage was relatively high as compared with municipal sewage, but on the average somewhat lower than that of the national army camps. The amount of sewage consumed at the various fields, was approximately the same as the amount of water, but in some cases was slightly more (probably due to infiltration of ground water through imperfect joints) and in other cases was slightly less. Much greater was the variation in per capita amounts. These varied from a minimum of 61 gallons per capita per day of sewage in Selfridge Field to 274 in Brooks Field. Of 25 fields for which the figures are available, 12 had a sewage flow of more than 100 gallons per capita and four of more than 150 gallons. The greatest infiltration of ground water was probably at Kelly No. 1, where the water consumption was 171 gallons and the sewage flow 215 gallons. The greatest difference in the other direction was at Scott, where the water consumption was 194 gallons and the sewage flow 66.6 gallons. The highest rates ordinarily occurred between six and nine oclock in the morning and the same hours in the evening. From midnight to six in the morning the flow became almost nothing at some of the fields· Relative to the water consumption, Captain Craig said: "The quantity was abundant and was enough for all the essential needs of the posts in addition to the non-essential needs such as the sprinkling of roads and lawns, lavish use of water for bathing, etc. Water was furnished under adequate pressure with sufficient reserve equipment for fire pressure." As a result of the large consumption of water, the sewage was weak. As the sewer systems were simple and small the raw sewage as received at the treatment plants was fresh and uncomminuted.

The grease problem was the real one and had not been successfully solved at the time of the signing of the armistice and not much has been accomplished since. In the original design of the field sewer systems, small cast-iron sink traps were used, these being usually augmented by an outside trap of vitrified clay pipe or cast iron. Because of the large quantities of water used in the camp kitchens, together with the small size of the traps, little opportunity was afforded for the cooling of the water and the separation of the grease. The result was that most of the grease was carried on to the sewage treatment plant. In the summer of 1918 large concrete traps, similar in design to the type adopted by the Construction Division for the National Army Camps, were installed for experimental purposes on some of the camp outfall sewer lines, but were found to be impracticable, as the grease was mixed with large amounts of fecal matter. On the other hand, the type of large concrete trap adopted by the Construction Division to collect grease from a row of kitchens has been found to be practical and to effect a high ratio of grease collection, but means must be provided for frequent removal of organic matter such as corn, peas, etc., which gathers rapidly at the bottom of the trap, and in which bacterial decomposition and putrefaction soon set in if they are not removed frequently. The grease collected was either burned or was sold along with the garbage.

CONSTRUCTION DETAILS.

Loveland Farms.—All trenches in the Loveland Farms development were opened by means of a Keystone excavator. In one section rock was encountered continuously in the bottom of trenches at a depth varying from one to five feet below the ground surface. This required extensive drilling and blasting, which allowed the machine excavation to proceed far in advance of the pipe laying. While the main trench was being excavated, house connection trenches were opened by hand, surplus labor available at any time being used for this purpose. A combination trench was dug for sewer and water mains together, having an irregular section which, together with the many angles in the line, favored the use of the Keystone type of trencher. This type of machine was further favored for the reason that it is readily adaptable for use in lot grading or backfilling. However, the large amount of lot grading to be done required the use of a steam shovel, and an Erie shovel was used provided with I-beam trucks for support across sewer trenches· It was recognized that the shovel had disadvantages due to the distance of spoil piles from the center of the trench when operated on I-beams, and the necessary loss of time occurring at each angle of the line. However, the general utility of this equipment was held to counterbalance these disadvantages. The Keystone machine was used for backfilling most of the trenches.

With a few exceptions, all pipes were laid with cement mortar joints, this mortar being mixed in the proportions of 1 part cement to 2 parts of sand. Considerable care was given to securing good joint work, with the result that the following procedure was adopted. In making joints, a single ring of jute, soaked in cement grout, was first placed in the bottom of the bell of the pipe already laid. This jute was covered with a pad of cement mortar, filling the lower portion of the bell and extending over the edge of the bell to form a liberal ring in front of the pipe already laid. The spigot end of the following pipe was then inserted in the bell, care being taken to prevent forcing of mortar pad into the interior of the pipe. After insertion of the spigot, the ends of the jute ring were wrapped around the pipe and caulked into the bell, after which the entire joint was filled with mortar by a trowel or rubber glove. All joints were given a mortar bevel trowelled to a smooth finish· This method of forming joints eliminates the necessity for excavating bell holes and insures a full mortar joint in the lower half of the pipe.

Joints were allowed to harden slightly before back-filling, and after this hardening, loose earth, free from stone, was filled to half the height of the pipe and tamped to afford a bed for the lower portion of the sewer. A second layer of earth was then deposited to a depth of six inches above the top of the pipe and carefully tamped, after which earth filling was placed upon the pipe to a depth of 18 inches above the top by hand and the remainder of the back-fill then completed by machine, no further tamping being done.

In all pipe laying, a swab was drawn through the pipe immediately behind the pipe layers to remove all particles of mortar entering through the joint. In addition to this, the interior of the pipe was inspected with mirrors before back-filling, to insure satisfactory condition of the line.

Before final acceptance of the work, a wooden test ball, one inch smaller in diameter than the nominal size of the sewer, was flushed through all main lines. This served to remove all foreign material which had entered the line and insured freedom from clogging in the future. Where necessary, chain scrapers were used to remove hardened deposits of material which had entered the line in the course of construction.

As nearly all trenches were sufficiently dry for the use of cement joints, no special compounds for jointing in wet trench were maintained on the work. However, in some instances, springs were encountered which could not readily be drained by pumping and in these cases other means were adopted. A practice occasionally used was that of cementing several lengths of pipe together and wiring them to planks about 12 feet in length, after which the cement joints were allowed to harden. These plank sections were then lowered into the trench and connected by means of leadite joints poured under water, leadite being used in this case as it was readily available from work on the water line.

In the manholes first constructed, adjustable forms were used to form the channels in the concrete bottoms, but considerable trouble developed in this method from the flowing of cement concrete into the pipes already laid. This method was therefore discontinued and vitrified clay pipes were laid directly through the manholes by means of specials, the concrete base being then cast around the pipe and the upper portion of the pipe being removed later to form an open channel.

Granulated slag was used extensively to provide a cushion for the bedding of pipe in the trench and was, during the winter period, extensively used for blinding, as all spoil piles were solidly frozen until late in the spring. Another difficulty in connection with winter and spring construction was the collection of considerable depth of soft, running mud in earth trenches due to the thawing of the clay banks. This mud was of such consistency that it could neither be shoveled nor pumped and resort was had in some instances to primitive bailing methods. In many such trenches it proved particularly difficult to obtain a firm foundation at the proper grade and in these instances it was found that granulated slag was particularly useful. This material, when mixed with the soft clay in the trench bottom, absorbs the water and forms a foundation equally as good as the planking.

Street inlets consisted of a circular pre-cast concrete bottom section of uniform height, with a variable height of upper circular section poured in place. The bottom section has a rounded interior, thus preventing the accumulation of sediment and being directly connected with storm sewers by a 12-inch pipe. When handled under yard conditions, it was found that the forms for these inlets showed little damage from use and that numerous pourings could be made with a single set of forms. As the distance from the invert of the inlet to the curb level varied in all instances, a variable section was cast in place as desired. The forms for this work consisted merely of circular inside and outside forms resting on the pre-cast section previously placed, the concrete being poured in connection with sidewalk or other concrete work in the vicinity.

As previously described, a limited number of houses near the upper end of each house sewer lateral were permitted to connect their roof-water leaders directly to the house sewer. In making this connection, roof water drains were tapped and vented before discharging into the house sewer, in such a manner as to prevent sewer air from following roof-water conductors to the vicinity of open windows.

Emergency Housing Projects.—Manholes in these projects were generally constructed of brick, with intervals between them not greater than 300 feet. The iron covers for the manholes were made without perforations in order to prevent the entrance of surface water, provision for ventilation being made through the house connections. Drop manholes were used as in general practice, the drop being made through the manhole where it was less than 2½ feet, but outside the manhole where the drop was 2½ feet or more.

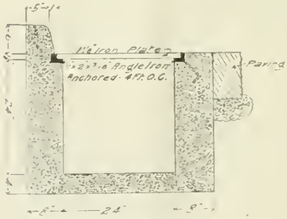
Where the grade at dead ends could not be made as great as one per cent, flush manholes were provided. These were constructed like an ordinary manhole and were connected with the water system by means of a galvanized pipe provided with a spigot. A shear gate with chain attached was placed at the outlet of the manhole, which allowed the manhole to be partly filled with water which, the gate being raised, provided the necessary flushing wave for cleaning the sewer. This was preferred to the automatic devices, which the engineers considered wasteful of water. Pipe joints were constructed of cement with a narrow gasket of hemp or jute, finished with a beveled outer surface; but in wet trenches where considerable ground water was encountered, an approved bituminous material or joint compound was used in place of cement mortar.

(To be continued)

Combined Sewer and Gutter

In planning a storm-water sewer in a street of West Orange, N. J., to discharge into a brook and extend for a distance of 500 feet therefrom, it was found that a house sewer in the center of the street, a water main on one side and gas main on the other, with their house connections, made it impossible to lay a storm sewer in the usual manner without placing it below the level of flood water in the brook.

To meet this condition, town engineer Chas. A. Winston designed and built a combined curb, gutter which cost $5.55 per lineal foot and has been in satisfactory operation for several months.



COMBINED CURB, GUTTER AND SEWER.

The structure consists of a channel under the gutter 24 inches wide and deep with concrete walks 8 inches thick and a concrete bottom 4 inches thick. One side is continued to the sidewalk level and serves as a curb. The channel is covered with an iron plate 1⅛ inches thick, which rests on 1 x 2 x 3/16 angle irons set into the sides of the channel; this plate being flush with the roadway pavement and serving as the gutter. The outside bottom of this channel is just about level with the tops of the gas main and water main and is 18 inches above the sewer.

Concrete Poles for Wires

The Water Department of St. Louis, finding it necessary last year to replace some of the poles carrying the trolley wires of the water works railway, investigated the use of concrete poles, since poles of cedar or other wood were difficult to obtain and high in cost. It was found that the concrete would cost but little more than cedar, and forms were made and 37 poles cast and are now in service.

Freight on Road Materials

The United States Railroad Administration, under date of December 29, announced that "the 10-cent freight reduction on shipments of stone (broken, crushed and ground), slag, shells, chert, sand and gravel is extended to and including February 29, 1920."

The WEEK'S NEWS

Highway Progress in Oregon and Maine—U. S. Bureau of Education Disapproves School Closing in Epidemics—San Francisco Plans Purchase of Water System—Portland, Ore., Sues for Cost of Fighting Fire—Fire Department Unionism in Boston and San Francisco—Bond Defaults in Canadian Cities — New York Plans City Transit Ownership—Laboratory Tests for Auto Headlights in Pennsylvania.

ROADS AND PAVEMENTS

Oregon Spends $7,000,000 On Highways.

Salem, Ore.—Expenditures under the supervision of the state highway department for the fiscal year ending November 30, 1919, totaled $6,903,930.56, according to a statement issued by the department. The amount comprises expenditures of $6,277,741.04 from state funds, $325,050.01 from county funds and $301,139.51 from federal funds. The expenditures do not cover the cost of all work completed during 1919, approximately $1,000,000 payable to contractors being retained under a statute limiting payments on contracts to 85 per cent of the amount due until all work under the contracts is completed. The total expenditures are segregated as follows:

On federal aid post roads	$ 889,785.80
On federal aid forest roads	321,942.46
On all other state highway construction	4,915,229.11
On maintenance work	15,494.93
On interest on bonds	146,630.36
On equipment	214,045.84
On survey and engineering county construction	254,050.67
On administration and general supervision	146,753.39
Total	$6,903,930.56

Paving Contractors Win Claim Against City.

New York, N. Y.—A judgment of $418,861.36 against the city of New York has been obtained by the Uvalde Asphalt Paving Company in the Supreme Court of New York county. The sum named in the judgment was the amount asked by the plaintiff as due it by reason of negligence on the part of the city in co-operating with the Uvalde Asphalt Paving Company in a paving contract. The Uvalde Company claimed that the city's failure to aid it resulted in two and a half years more work than was necessary on the contract. The trial lasted nearly three weeks. The city expects an appeal. The contract in question was one which involved $1,049,609 expense to the city of New York in paving the Grand Concourse and Boulevard in the Bronx, a stretch of 4.1 miles, 182 feet wide. The work was started Oct. 2, 1902, and was wound up in November, 1909. This time included the delay of 2½ years, which the Uvalde Company claims was caused by the city's delay in letting contracts necessary to the work and in forcing the removal of railroad tracks barring the way.

$4,000,000 for Maine Roads Next Year.

Augusta, Me.—Four million dollars for the construction of roads will be available next year in Maine. Half of this money will come from the state and the other half from the Federal Government, and it is expected that 150 miles of new state highways will be constructed. These new pieces of road will be so located that they will largely make connection between sections of state highways already completed. Labor will be the factor which will govern the amount of road work that will be done next year, and Paul D. Sargent, the chief engineer of the state highway commission, does not expect that wages of workmen will be any lower than during the present season, when men received from $3 to $4 a day, according to the locality. The experience of the highway department in hiring labor is that men who live near the cities, or rather where the work is nearer the cities, demand more pay than they do in the country districts. All of the work to be done next year will be federal aid jobs. Projects are being put into shape and presented to the federal government for approval as fast as possible, and the highway commission plans to let contracts at as early a date as the work is in condition to let. With this thought in mind, the highway commission early in September let a contract for 9.35 miles of bituminous macadam road in the town of Vassalboro, Kennebec County. The contractor has been able to lay practically all of his culverts this fall and do part of the heavy grading. Letting work early or in anticipation of next season's construction allows the contractors plenty of time to make all the arrangements for getting equipment on the job, for securing all necessary material and other details before the actual building begins. It is thought that this may tend to lower prices, as in many cases contractors can deliver and stack alongside the roads, gravel, stone and sand during the winter months when their teams otherwise would not be busy and when large loads can be hauled on wheels. Because of lack of funds, only 20½ miles of road were constructed during the present year. This work consisted entirely of finishing up contracts outstanding at the end of the year 1918.

SEWERAGE AND SANITATION

State University Gives Health Advice in Newspapers.

Chicago, Ill.—The department of hygiene and public health of the University of Illinois has inaugurated a press bulletin service whereby the larger newspapers of cities throughout the state will be supplied weekly with news stories and information articles pertaining to public health, hygiene and sanitation. This is announced to be part of the university's public health education work, the articles being contributed by members of the faculty who are authorities on their particular branches of health work. The initial bulletin contains three articles: One on warding off influenza by sterilizing eating utensils, one dealing with the care of the influenza patient, and one entitled "Poor vision a common cause of inefficiency." The articles are well written, the information is accurate, the advice serviceable, and altogether the service thus inaugurated is expected to be of considerable help in promoting health education of the people.

Value of Closing Schools During Epidemics.

Washington, D. C.—"Closing schools as a means of controlling epidemics of measles, whooping cough, scarlet fever, diphtheria, smallpox, and poliomyelitis should be considered as a last resort to be used only when thorough and systematic application of other measures fails to enact control. As a method it is clumsy, unscientific and unsatisfactory, for it fails to control and results in the loss of school time and money. The modern method of careful daily inspection of infected schools, isolation of sick children, and quarantine of contacts, is both more effective and economical." Such is the summary of a report made by a committee of the Bureau of Education co-operating with a similar committee of the American Public Health Association. This committee consisted of Dr. W. S. Small, Bureau of Education, chairman; Dr. W. C. Woodward, health officer, Boston; Dr. F. G. Curtis, health officer, Newton, Mass; Dr. Bernard Kahn, acting director of medical inspection of public schools, Philadelphia; Dr. Taliaferro Clark, United States Public Health Service. The inquiry of the committee developed that state laws show very few specific statutory references to the matter, rather general authority being vested in an administrative body. The review of literature showing that there has been a progressive abandonment of faith in, and practice of, closing schools as a means of controlling epidemics affecting school children. Such exceptions as were found in the literature related to the following special conditions: Inadequate medical supervision of schools; severity of epidemic that defies all efforts at control, and epidemics in which the etiology of the disease is unknown, such as infantile paralysis, epidemic meningitis and possibly a few others. The successful control of epidemic diseases among school children requires: 1. Keeping the schools open, with the possible exception of sparsely settled rural districts, when medical inspection can not be obtained and where the aggregation takes place only in the schools; 2. Careful daily or frequent periodical inspection of schools; 3. Careful provision for exclusion of cases and contacts, emphasis being placed on clinical data rather than upon fixed periods of exclusion; 4. Systematic home visitation; and 5. Reliance upon natural and physical cleansing rather than upon chemical disinfectants.

WATER SUPPLY

Water Rates Increased.

Davenport, Ia.—The city council has adopted a resolution authorizing the Davenport Water Co. to increase its rates as follows: Minimum rate, 70 cents per month for 2,000 gallons; $8.40 per year for 24,000 gallons. For unmetered consumers, first 20,000 gallons in month, 35 cents per 1,000; over 20,000 gallons in month, 11 cents per 1,000. The present rate for minimum consumers is 60 cents a month or $7.20 a year. For unmetered consumers, the first 20,000 gallons, 30 cents per 1,000; over 20,000 gallons, 10 cents per 1,000.

San Francisco Proposes to Buy Water System.

San Francisco, Cal.—Declaring the purchase by the city of the Spring Valley system to be the only sound procedure, from an engineering and economical standpoint, to serve San Francisco with water from Hetch-Hetchy, the special water committee of the Supervisors has presented its report at an informal meeting of the Board. In its report, which is concurred in by city attorney George Lull and the city engineer, the committee asks that it be directed by resolution of the Board to request the Railroad Commission to fix a fair and equitable price on such parts of the Spring Valley properties as the city may determine to be necessary in connection with supplying the city with water. The report also recommends that the Board agree by resolution to submit the proposition to the voters. While not urging undue haste, the committee suggests that a policy be decided upon as soon as possible, for the reason that Spring Valley has asked the Railroad Commission to increase its rates in order that it may build a $12,000,000 pipe line and also because the city's water supply is at a dangerously low ebb. The report deals with engineering features, industrial and economical reasons, legal aspects and embodies the recommendation of the city engineer and a supplemental report on finance, dealing with revenues and the city's bonding capacity. After referring to the present criticial condition of the water supply, the report says:

> The amount of storage facilities within the city limits is inadequate to give the city safe protection against conflagrations or other catastrophes if, for any reason, the mains crossing the fault lines on the peninsula should be ruptured. These deficiencies can only be satisfactorily remedied if the city acquires, owns and operates its water supply as a whole and in conjunction with the great mountain supply from Hetch-Hetchy now under construction. The Hetch-Hetchy project now under construction terminates at the Amazon reservoir within the city limits. Either the city must make provision for the construction of an independent adequate distribution system, largely duplicating the existing system, in order to distribute Hetch-Hetchy water to its inhabitants, or it must acquire the distribution system of the Spring Valley Water Company, including the necessary local storage on the San Mateo peninsula. The former alternative from the standpoint of engineering and public economy is almost unthinkable, and, due to the fact that the company owns practically all the desirable peninsular storage sites, its adoption would enable the city to build the local storage necessary to adequately project its water supply going through a conduit 160 miles in length.

Pointing out the waste which would result from the construction of two costly pipe lines, the report says:

> Within the last six weeks the company has filed a formal petition to the Railroad Commission, asking that these rates be increased by about 16 2-3 per cent, for the avowed purpose of enabling the company to finance the construction of a high-line conduit from Calaveras reservoir to San Francisco, costing approximately $12,000,000, and to refund its bonded debt, which matures in 1923. The City Attorney has filed an answer to this petition, opposing any increase in the rates and opposing approval by the Commission of the construction of the proposed conduit line.
>
> This opposition was based on the grounds that to build the proposed high-line conduit from Calaveras to San Francisco would involve the expenditure of $12,000,000 upon which San Francisco's water rate payers must pay a return for a conduit which could never be used in connection with the Hetch-Hetchy project on account of the high elevation at which it is planned to be built. The latter fact, in turn, would necessitate a needless duplication of conduits in order to bring Hetch-Hetchy water into San Francisco.

It is pointed out that if the city continues its present Hetch-Hetchy construction and buys the Spring Valley properties, at the end of three years it may expect to be in a position to earn $2,000,000 net revenue from the present Spring Valley sources and an additional $2,500,000 to $3,000,000 from the Hetch-Hetchy power development and the transbay water development.

FIRE AND POLICE

City Sues for Fire Fighting Cost.

Portland, Ore.—First proceedings under the personal liability ordinance passed a year ago at the instance of the fire department have been started by deputy city attorney Stanley Myers against Fink Brothers, coopers. Charging that the firm disregarded a specific warning on the part of the fire marshal and that a fire resulted, an effort will be made to force the company to pay to the city all costs connected with the services of the fire apparatus required to extinguish the blaze. This, it is understood, will amount to hundreds of dollars. The city charges that fire marshal Edward Grenfell served notice on the cooperage plant by letter to abate fire risks on July 12, 1918. The points demanded were that the system of heating barrels be transferred to a fireproof room, that shavings be removed from the floors daily and that improvements be made in the heating system. No answer to this letter was received and it is charged that the conditions pointed out were not corrected. A fire occurred on December 2 of this year and the city is determined that inasmuch as this menace was specifically pointed out to the operators over a year ago they must pay for the use of the fire apparatus, firemen's wages and water consumed in extinguishing the blaze.

Boston Fire Officers Give Up Union.

Boston, Mass.—It is thought that the rank and file of the fire department will in the near future follow the example of their officers and surrender their charter of affiliation with the American Federation of Labor. There has been no announcement of such a purpose, but it is understood that a movement is under way. The Officers Club has voted 91 to 9 to surrender the charter, thus following the lead of their chiefs. This club has been affiliated with the International Association of Fire Fighters, which is also affiliated with the American Federation of Labor. There are 150 officers in the department, so that a large percentage of the members did not vote. The Russell Club had been for years a powerful political instrument in the hands of the Boston firemen before the labor union was established. Fire commissioners had confessed that its power was subversive of the best interests of the force, yet none of them saw fit to suppress it. The union was formed during the administration of mayor Curley and was regarded by city officials as the last step in organization development of city employes. The firemen realized that they did not have the support of the administration, but they did nothing to embarrass mayor Curley in his dominance of the department. The first show of strength and determination under organization influence came in the campaign the firemen made in behalf of the ordinance establishing one day in three for time off. It was a campaign of irresistible effect on the city council. Despite the fact that fire commissioner John Grady was opposed to the change and that mayor Curley was also unfriendly, the firemen won. This was followed, more than a year ago, by the privates and the officers of the department joining hands in the effort to obtain from mayor Peters a large increase of salaries. The scale, affecting all groups, from the commissioner down, was handed to the mayor by the representatives of the two unions affiliated with the American Federation of Labor. It was presented mildly, yet insistently. Later conferences revealed the serious temper of the men. A strike was hinted for weeks and it was predicted that the weight of the American Federation of Labor was exerted in behalf of the firemen. When the Boston police deserted their posts labor leaders gave them the assurance that the firemen would strike in sympathy. Many conferences were held and strongest pressure brought to bear for a strike. While many powerful labor leaders advised such a course, others were opposed to it. The firemen remained on duty, but for days fire commissioner Murphy was busy in organizing a force to take the places of the firemen if they had followed the police. At the time the firemen organized assurances were given the city officials that, come what might, the organization would never vote to strike. But if the firemen would not strike to enforce their demands, union organization would be no more effectual than the old influence of the Russell club, a social organization. It has been reported that there was certain sentiment in the department for a withdrawal from the American Federation of Labor at this time, with the officers. Certain retarding influences have been at work, and progress delayed. Mayor Peters is anxious to see the fire department in a state of efficiency and esprit de corps like that of the old days under commissioner Russell. He feels that the morale had sunk to a low ebb when he came into office, and it was for that reason that he appointed John R. Murphy in the hope that a strong disciplinarian would bring the department back. Mr. Murphy is going ahead with his plans with painstaking care. Radical treatment may be necessary to fulfill the mayor's hopes. There may be retirements, promotions and transfers. The appointment of a new chief was the first step, and it has had an effect not lightly to be regarded.

Firemen's Union Forbidden.

San Francisco, Cal.—Fire commissioners have forbidden any member of the fire department to join a labor union or affiliate with any organized forces of labor which have the power to call a strike. The action was taken after a report from one of the commissioners that Eugene Mulligan, a hoseman, had been seated in the San Francisco labor council as a delegate from the Fire Fighters' Union of San Francisco.

GOVERNMENT AND FINANCE

Investigate Canadian Cities' Bond Defaults.

Edmonton, Canada.—A judicial commission has been appointed by the Alberta Government to inquire into the affairs of the municipalities of that province which have defaulted their obligations. The muncipality to be dealt with will be the town of Wetaskiwin, and it is felt that the proceedings of the commission in regard to Wetaskiwin will be of the utmost importance, inasmuch as any action taken in regard to its bonds will probably be adopted as a precedent to be followed, with the necessary variations due to local conditions, in the case of the other municipalities, to be dealt with later—Athabaska, Tofield and probably Macleod. The bondholders have already prepared memoranda to be placed before the commission, suggesting certain measures to be taken in the case of Wetaskiwin. The principal recommendations made by the bondholders are as follows:

> That taxes on improvements to be increased to 55 per cent of 65 per cent of their value, and that a petition be presented to the legislature to amend the charter of the town so as to enable it to assess improvements up to 75 per cent of their value.
>
> That the business assessment is increased.
>
> That the public utilities be put upon a paying basis; that is, that the rates charged for services be increased sufficiently to meet not only operating charges, but interest and other charges.
>
> In the case of the waterworks, that the water rates be increased sufficiently to bring in a revenue, which could be applied to the reduction of the overdue interest payments.
>
> That the debt to the local bank be funded.
>
> That interest payments up to the end of 1919 be funded and spread over a term of ten years.
>
> That in calculating the rate of taxation allowance be made for taxes that will not be collected.

It is generally felt that although the finances of the town are in very poor shape, the bondholders will not lose out in the end. The Municipal Finance Commission of Alberta is headed by Chief Justice Harvey, and its decisions become effective upon being approved by 60 per cent of the bondholders of any municipality whose affairs are investigated and after being passed upon by the Lieutenant-Governor in Council which means the Provincial Cabinet.

Light Sentence for Muncie Mayor.

Muncie, Ind.—Mayor Rollin H. Bunch has been sentenced to serve two years in the Atlanta prison and pay a fine of $1,000 for participation in a fake prize fight scheme. Prosecuting attorney Murphy was given a similar sentence. Twenty-one others got varying prison terms and fines. They included well known Muncie men, members of the police force, and men from other cities.

TRAFFIC AND TRANSPORTATION

Plan City Ownership of Transit in New York.

New York, N. Y.—It is urged that the difficulties confronting the traction companies in the city because of lack of sufficient revenue will be immediately removed if they accept a plan worked out at five conferences of representatives of the companies, transit construction commissioner John H. Delaney and public service commissioner Lewis Nixon. The traction officials will submit the plan to the board of directors of the various companies as early as possible. The plan entails: (1) transfer to the city of all titles held by the companies in railroad properties; (2) guaranteed payment by the city of a reasonable rate of interest on fair appraisals; (3) setting aside of 1 per cent. for the purchase of the properties at the expiration of thirty-eight years; (4) a sufficient increase in fares to meet these requirements; (5) all else connected with the plan are matters of detail which it was agreed could be worked out if the companies agreed to relinquish control of their properties. Commissioner Delaney is author of the idea which is largely based on the city's municipal ownership plan and the need for getting possession of the railroads without the immediate payment of a large amount of money, which would be practically impossible because of the debt limit restrictions. Mr. Delaney stated that no proposal had been made by the companies, that what the city thought was the solution of the traction problem was set forth, and that if the concessions suggested were presented to the Board of Estimate they would have to be presented by the companies themselves. Mr. Delaney explained that one of the prerequisites for the solution of the transit problem was city ownership "of any and all such lines as the city may desire to acquire. Such lines will in any event include all of the rapid transit lines, both subway and elevated. Title to these properties must vest in the city at once. The matter of values must be agreed upon through negotiation before any municipalization project could become effective, and all existing leases, contracts and agreements for high rents and dividends must be abrogated, and only a fair interest return paid on such capital in the way of stocks and bonds as is proved to cover the fair value of the properties." Mr. Delaney explained that the dual system contract points the way the city may acquire complete municipal ownership of all the rapid transit lines without overleaping the debt-incurring capacity of the city, and without violating restrictions placed upon the city in this respect by the state constitution. This contract permits the Interborough Rapid Transit Company to obtain possession of the partly completed Steinway tunnel and to assign it immediately to the city. "This principle," said Mr. Delaney, "could be applied to the acquirement by the city of the elevated railroads or any other transit property and complete municipal ownership be obtained on a basis which might be characterized as on credit terms, and full payment be spread over the period of amortization. Any contracts made on this basis should also secure to the city the privilege of taking possession at any time it saw fit by payment of the full purchase price agreed upon." Concerning the surface lines he said: "Representatives of these lines are asking the city to permit them to charge an eight, nine, or ten cent fare in order that owners of some of these lines may continue receiving as high as 18 per cent. dividends. Large amounts of money have been spent in improving these lines which will revert to the owners if these excessive payments are not continued. The lines are hiding behind a tangle of red tape. There is no doubt that the time has come when all of the wrongs committed against the interests of the people should be corrected." Under city ownership, Mr. Delaney said, the fare would be less because the city would not have to pay federal or state taxes on income, and that it would be relieved of other charges which now burden the railroads. It appears that the general plan for managing the roads, if the city takes them over, is to have the present companies operate them, to have a representative of the city on each directorate, and to run the lines generally on the existing plan plus the keeping up of the service to the highest point of efficiency which lack of money has not enabled the companies to do in the recent past.

City Completes Street Railway Company Valuation.

Houston, Tex.—The final valuation which the city will concede to the Houston Electric Company is $5,110,771, according to the final figures arrived at by Lamar Lyndon, the city's rate expert. They were slightly lower than the estimated figure Mr. Lyndon gave before his departure for New York. Assuming a net valuation of $5,000,000, Mr. Lyndon finds that $622,075 net revenue will be required to bring the company a return of 8 per cent. and 4½ per cent. depreciation. He finds that by deducting the annual increase in real estate values, the net return for 1919 should be $598,000. He says that under the circumstances, 7 to 7½ per cent. should be an ample net return on the value of the Houston property. Hence, the projected net return for 1919 is slightly in excess of the amount which "reasonable considerations" would dictate. Mr. Lyndon finds that the net income required for a 7½ return with 4½ per cent. depreciation is $573,000, and for 7 per cent. is $548,000. The engineer's original recommendations concerning net return and depreciation, the fare to be established, arrangement of a partnership between the city and company, modification of jitney competition, better traffic conditions and compulsory skip stops, stand without a change. Meanwhile the company is suing in Federal Court to have a valuation of its property made preliminary to determine what is a fair rate of return on the property.

Laboratory Tests for All Auto Headlights.

Harrisburg, Pa.—The state highway department has announced that certificates of approval of automobile headlight lenses and devices will be made only after laboratory tests of the lenses or devices. All lenses submitted for approval must undergo the laboratory test. Highway department inspectors, equipped with proper testing devices, will frequently be encountered on the highways of Pennsylvania by night travelers. These inspectors, however, will determine whether the headlights on an individual car, which appear to them to be producing glare in violation of the recent Act of Assembly, are really sending out improper candlepower to such an extent as to be a menace. By means of what is known as a photometer the inspector can obtain a quantitative confirmation of his opinion. If results show that the offense is flagrant the department will be able to proceed with more definiteness than would be possible if the degree of the offense were to be obtained only by unaided vision. The inspector, in other words, will make the road inspection to see whether proper lenses or diffusing devices are used; and if so whether the car owner is using bulbs below or above requirements. Road tests for the approval of lenses are deemed impracticable because conditions, to be fair to all lenses, should be comparable in every way with conditions existing in the laboratory—which would include proper focusing in accordance with specifications accompanying the headlight device; burning of the lamps under constant current conditions, giving definite candlepower; and the use of meters or photometers of accuracy corresponding to laboratory instruments.

LEGAL NOTES

A Summary and Notes of Recent Decisions—Rulings of Interest to Municipalities

Injury to Tug by Drawbridge—Liability of City.

(U. S. D. C. Mass.) A city, as operator of a drawbridge, and a steamer, both held in fault and liable for injury to a tug assisting the steamer through; the steamer because of negligent operation of her engines contrary to signal, causing her to move ahead and strike the swinging draw, and the city because the bridge-tender negligently allowed the draw to overswing and strike the tug.—New England Fuel & Transportation Co. v. City of Boston, 257 F. 778.

Municipal Taxing Authorities—Interference by Courts.

(Ga.) Courts should not interfere with discretion of municipal taxing authorities, unless it appears that tax imposed for revenue is unreasonable in amount or discriminatory.—Western Union Telegraph Co. v. City of Fitzgerald, 100 S. E. 104.

Special Assessment—Construed in Favor of Owners.

(W. Va.) A statute purporting to impose liability upon one or more property owners to the relief of other taxpayers, by way of a special assessment for improvement or maintenance of a public road, street or alley, is to be construed strictly, and any doubt as to its scope will be resolved against the public and in favor of owners.—Bonham v. City of Charleston, 100 S. E. 222.

Paving Material Used by City—Payment.

(Cal. App.) City and county of San Francisco, having accepted, used, and retained pavement material which the board of supervisors had the general power to authorize board of public works to purchase, could not refuse to pay for it upon ground that certain provisions of the charter or ordinances were not strictly complied with.—Warren Bros. Co. v. Boyle, 183 P. 706.

Sidewalk Construction Contract Not Negotiable.

(Ind. App.) Sidewalk construction contract is not a negotiable instrument.—State v. Aubrey, 124 N. E. 278.

Street Cleaning and Garbage Collection Contract—Retention of Money by City.

(Mass.) Where the city of Boston contracted for the collection of ashes, removal of snow, street cleaning, etc., the contract providing for the retention of money by the city to settle claims for materials or labor furnished in carrying on the contract, but not for services connected with the work, because the city retained money beyond what was necessary for its own protection under such clause of the contract, there arose no implied common-law equitable lien for the payment of claimants who furnished the contractor single and double teams with or without extra men, and carts without either horses or men; the charge in each instance being for a single sum for hire of one single team, or one double team, or one double team and two helpers, such contract not being "for materials or labor furnished."—Loonie v. Wilson, 124 N. E. 272.

NEWS OF THE SOCIETIES

Jan. 14.—NEW ENGLAND WATER WORKS ASSOCIATION. Annual meeting, Hotel Brunswick, Boston, Mass. Secretary, Willard Kent, Narragansett Pier, R. I.

Jan. 16, 17. — WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Annual meeting, Kansas City, Mo. Secretary, G. W. Thurston, 416 Dwight Bldg., Kansas City, Mo.

Jan. 19.—AMERICAN INSTITUTE OF CONSULTING ENGINEERS. Annual meeting, New York City. Secretary, F. A. Molitor, 35 Nassau street, New York City.

Jan. 21, 22.—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting, New York City. Secretary, Charles W. Hunt, 33 West 39th street, New York City.

Jan. 28. — WESTERN SOCIETY OF ENGINEERS. Annual meeting, Chicago, Ill. Secretary, Edgar S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Feb. 9-13.—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention, Louisville, Ky. Secretary, E. L. Powers, 150 Nassau street, New York.

Feb. 16-18.—INTERNATIONAL CITIES AND TOWN PLANNING ASSOCIATION. Annual meeting, London, England. Honorary secretary, C. B. Purdon, 3 Grays Inn Place, London, W. C., England.

Feb. 20-21.—AMERICAN CONCRETE PIPE ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, G. E. Warren, 210 South LaSalle street, Chicago, Ill.

May 18-21. — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

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Society for Electrical Development.

At a recent meeting of the Board of Directors of the Society for Electrical Development held at the society's offices, in the Engineering Societies building, New York, W. W. Freeman was unanimously elected president of the organization, succeeding Henry L. Doherty, who has held that office since the founding of the society nearly six years ago.

As president of the Union Gas & Electric Co. of Cincinnati, Mr. Freeman is well known to all branches of the electrical industry. Being vice-chairman of the Public Policy Committee of the National Electric Light Association, of which committee Mr. Freeman was chairman for a number of years, the new president brings to the society a broad experience in dealing with matters pertaining to the relations between the great electricity consuming public and the people who produce and market the energy and devices through which it is used.

Under his leadership the society will continue its excellent work of coordinating and assisting all branches of the electrical industry to bigger and better business as well as carrying to the public the message "Do It Electrically."

Under the guidance of Mr. Doherty, its past president, the society has done a big work in getting the various branches of the industry together.

At a meeting of Advertising and Publicity Service Bureau of the Commercial Section of the National Electric Light Association, held recently in Chicago, steps were taken to cooperate with the Society for Electrical Development to eliminate duplication of work and to further develop publicity.

New England Water Works Association.

The annual meeting of the New England Water Works Association will be held at the Hotel Brunswick, Copley Square, Boston, on Wednesday, Jan. 14. Following a meeting of the executive committee in the morning and a lunch at 1 p. m., the following committee chairmen will report on the work of their committees:

Standards of Purity for Water, Mayo Tolman; To Consider Collections and Standardization of Rainfall and Runoff Measurements, William T. Barnes; Revision of Constitution and By-Laws, Henry V. Macksey; Standard Specifications for Cast Iron Pipe and Special Castings, Frank A. McInnes; Uniform Accounting, Albert L. Sawyer; Standard Specifications for Fire Hydrants, H. O. Lacount; Revenue from Fire Service, William C. Hawley; Statistics of Water Purification Plants, George C. Whipple; Leakage of Pipe Joints, F. A. Barbour; Standard Specifications for Water Meters, Charles W. Sherman; Proposed Standard Schedule for Grading Cities and Towns of United States with Reference to their Fire Defenses and Physical Conditions, Frank A. McInnes; A National Water Law, Caleb M. Saville; Extension of Mains, Caleb M. Saville; National Department of Public Works, Henry V. Macksey.

Reports will then be read by the secretary, the treasurer, the editor and the auditors. Samuel E. Killam will deliver his presidential address. Election of officers will follow.

American Association of Engineers.

The results of the membership drive held during December by the American Association of Engineers have been finally tabulated. Buffalo Chapter won first prize for clubs having a membership of more than 100, with an increase of 318.4 per cent. For the chapter or club having less than 100 members at the close of the drive, the Ogden (Utah) Club won first place, with an increase of 209.9 per cent. The prize won by the Buffalo Chapter is a silk banner specially designed and indicating that Buffalo is the banner chapter of the association for 1919. A special gavel for chapter use was awarded to the Ogden club. The three members of the association obtaining the highest number of individual subscriptions were F. P. Obee, an engineer of Toledo, Ohio; J. W. Shera of Chicago, and Professor Samuel M. P. Dolan of the Oregon State College, who turned in respectively, 131, 100 and 66 applications for membership. The

(*Continued on page 18*)

PROBLEMS CITIES ARE STUDYING
WITH EXPERTS

SEWERAGE IMPROVEMENTS are to be made by Chandler, Okla., for which plans are being revised by the consulting engineers, V. V. Long & Co.

Plans are being prepared for PAVING, SEWERAGE and WATER IMPROVEMENTS in Haddonfield, N. J., by the consulting engineers, Remington & Vosbury.

WATER WORKS IMPROVEMENTS, including new water supply from Hill Creek and water works extension, are planned by Madill, Okla., to cost $400,000. The consulting engineers are Johnson & Benham.

Woodstock, Ont., Board of Health plans to make SEWERAGE IMPROVEMENTS, involving 2½ miles 30-inch reinforced concrete pipe and concrete sewage disposal plant, to cost $93,000. Plans are being prepared by the consulting engineers, F. J. Wire & Son.

Napanee, Ont., plans extension to WATER WORKS SYSTEM, including four miles 6-inch cast iron pipe to cost $50,000 and filters and pumps, $30,000. The town has retained E. A. James Co., Ltd., consulting engineers, to advise what additions should be made to system, should town decide to purchase it.

Leighton, Pa., plans improvements of WATER WORKS SYSTEM. The consulting engineers are Gannet, Seelye & Fleming.

Macon, Ga., is planning extensive WATER WORKS IMPROVEMENTS at pumping station, including the construction of a high levee around property. The consulting engineer is Geo. W. Fuller.

Benson, Minn., is having plans prepared to build a combined SEWERAGE SYSTEM to cost $80,000. The consulting engineers are the Bradley Engineering Service.

Enterprise, Ore., will vote on $50,000 additional bonds for PAVING IMPROVEMENTS, involving the paving of 35 blocks with concrete, asphaltic concrete or bitulithic. The consulting engineer is L. C. Kelsey.

Marathon county, Ballinger, Tex., plans to build a BRIDGE over Colorado river, including removing present structure and addition to present substructure. The bridge will be 518 feet long, reinforced concrete and steel girder, and will cost about $39,986. Plans are being prepared by the consulting engineers, Hess & Skinner.

INDUSTRIAL NEWS

The New York Continental Jewell Filtration Co., Nutley, N. J., announces that Arthur M. Crane has been appointed general manager, succeeding the late Robert E. Milligan. Mr. Crane was formerly general sales manager. D. C. Williamson continues as chief engineer. Mr. Williamson has been responsible for the design of plants and apparatus for nearly twenty years. E. K. Sorenson remains secretary and assistant treasurer. Messrs. Crane, Williamson and Sorenson are also directors of the company. The company is prepared, as heretofore, to assume the entire responsibility of designing and building complete plants, guaranteed to produce results in filtration, softening, iron removal, or other rectification of water; or to bid on plans and specifications of other engineers. It maintains a western office in Chicago and competent representation elsewhere throughout the world; but municipal filtration projects are handled direct from the general offices and works at Nutley, N. J.

Predicts Cord Tires Will Lead.

That solid tires for motor trucks will be obsolete within three years, street cars will soon be replaced by motor busses and freight cars given close competition by motor trucks on long hauls, were the predictions made by F. A. Seiberling, president of the Goodyear Tire & Rubber Company, and P. W. Litchfield, factory manager, at a banquet given the Detroit and Cleveland sections of the Society of Automotive Engineers in Akron recently.

More than 200 of the foremost designers heard Mr. Seiberling's prophesy that within the lifetime of those present, the United States would be criss-crossed by great highways of solid foundation to withstand any wear and that highways of less than 16 feet width would be unknown. He asserted that the ultimate tire would be the cord—that there would be no fabric or solid tires.

China as the future big market for tires was advocated by the speaker, who declared that the numerous post roads of stone would be excellent foundations for modern highways through that part of the Orient. He quoted statistics to show that 50 per cent of China's four millian people are employed in transportation against 10 per cent in the United States, and predicted a Celestial kingdom of motor transportation. Railroads cannot be built because of violating Chinese traditions in crossing burial places with the right of way.

Mr. Litchfield declared that the trolley must go, stating that it has reached a point where it cannot compete with the motor bus. For financial reasons extensions are impossible, so the street car must give way to the gas-driven vehicle that can aid development of suburbs without heavy investment in franchises and equipment.

Increase in traffic has sounded the death-knell of the trolley, according to Mr. Litchfield. Streets cannot easily be widened to give more track room. Continuous traffic movement is imperative. Therefore the whole street service must be utilized by a carrier that can go to the curb to take on or discharge passengers—the trolley must go underground as in London—if it remains in existence.

The Goodyear factory manager pointed out the immobility of freight cars and delays necessitated in waiting to make up trains for given destinations. In contradistinction he indicated the mobility of the motor truck and predicted that with permanent highways and cord tire equipment, the motor truck will replace the freight car on long hauls.

Mr. Litchfield asserted that the world war had put Europe 50 years ahead in transportation and with this future for the industry in mind asked the visiting engineers to design large capacity carriers to replace the street car and prophesied a multiple-wheeled truck would give competition to the railroads on long hauls.

Tests and Investigations by Bureau of Standards.

Among the recent investigations by the Bureau of Standards of the Department of Commerce were tests on frost action and fire tests of concrete columns.

Freezing tests were made by the Bureau on 15 samples of commercial sandstone. Several of these withstood 300 freezings with but few signs of disintegration, while the poorer grades were completely broken down by less than 100 freezings. One sample of granite passed 300 freezings without showing any signs of frost action, while a sample of porous limestone began to disintegrate at 150 freezings.

Twenty-eight full size columns of reinforced concrete have been constructed; 25 have been subjected to the combined fire and load test, and 7 have been tested cold, in compression. The work done has been two-fold in nature, and consists, first, of making and testing full size building columns of reinforced concrete from aggregates not previously included; and, second, in making and testing columns with protective material other than concrete. It has been found that columns made from the so-called Cow Bay gravel, a mixed gravel containing a large proportion of granite and gneiss pebbles, and columns made from pure quartz gravel gave results not quite so good as the columns made from Pittsburgh gravel previously tested. In the later column tests, the protective concrete spalled so badly early in the fire test, that a large part of the protective covering, after breaking up into slabs, fell away from the column exposing the steel and the load-bearing concrete to the fire. These columns failed under their working load before the completion of the 4-hour fire test. On the other hand, columns in which the coarse aggregate was trap rock showed no tendency to spall or crack seriously in the fire tests, and retained more than mined by load tests made while the columns were at maximum temperatures at the end of the 4-hour fire test. The results shown by columns in which the coarse aggregate was blast furnace slag were similar to those with trap rock aggregate.

NEWS OF THE SOCIETIES

(*Continued from page 17*)

prizes awarded these three gentlemen are life membership in the association, a $100 set of books and a $50 watch.

The captain of the membership team bringing in the greatest number of members on the Buffalo Chapter was F. A. Eschrich of Buffalo. T. M. Burlingame was drive commander for the Buffalo Chapter, and W. F. Turner acted a similar capacity for the Ogden club.

The chapters who stood after the Buffalo Chapter were Lincoln, Nebraska, with 310 per cent; the University of Nebraska, with 301.9 per cent. and the Toledo Chapter with 194 per cent. The largest number of applicants obtained during the drive was 474, obtained by the Chicago Chapter. Of this number, 100 were obtained by one man. The second largest chapter in point of number of applications was the Oregon Chapter, with 353. The number of applications obtained by the Buffalo Chapter was 242. It is interesting to note that the Lincoln Chapter and the University of Nebraska Chapter are located in the same city and that had they been consolidated, the chapter would have won first place.

The captain of the team in each chapter and club which obtained the most applications will receive a solid gold watch fob.

The membership of the American Association of Engineers, at the close of business on December 31 was in excess of 10,400, and the determination of the association to obtain 10,000 members before 1920 has been achieved with a large margin to spare. There were almost 7,000 applications for membership received in the month of December.

The recommendations for salaries for state highway engineers, prepared by the committee of the American Association on Salaries of Engineers in Public Service, which were endorsed by the American Association of State Highway Officials in December and by the meeting of the American Road Builders' Association, have been formally approved by the Executive Committee of the American Association of Engineers. Active steps to have this schedule placed in effect will be inaugurated early in 1920.

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City County State

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City officials and civic organizations are particularly requested to send to Municipal Journal and Public Works regularly their annual and special reports.

Information Bureau

The Information Bureau, developed by twenty-one years' research and practical experience in its special field, is at the command of our subscribers at all times and without charge.

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Private Preparedness vs. Public Procrastination.

Already merchants in the clothing trade are studying the styles for next summer and placing their orders, while manufacturers are deciding on the patterns for next fall. But Mr. Merchant and Mr. Manufacturer, as members of the city's board of public works or council committee on paving, sewers or water works, have not thought ahead even so far as next spring. They apparently act on the principle "Sufficient unto the day is the evil thereof," and that is a big reason why it so often *is* evil.

Whatever may be said about other features of municipal government, constructing public works is business, and cannot be done economically and otherwise satisfactorily unless business forethought be used by those in charge.

No Long-Time Bonds for Short-Time Roads

"Long-time bonds should not and must not be used to build short-time roads. We cannot consent to any improvement paid for with borrowed money—money borrowed for a long period of time—that is not an improvement of a durable type. Any other plan would be extravagant waste."

With these words the State Highway Department of Pennsylvania last month refused the application of one of the counties of that state for permission to issue bonds for constructing cinder roads. There can be no question about the wisdom of that decision for this and every similar case. Such a practice would as urely bring a disastrous day of reckoning as would living beyond one's income and issuing notes for the deficit.

Get Road Materials Now

There is money available for three times as much road work in 1920 as has ever been constructed in one year in this country. The problem is to get this amount of work done before next December—and it is going to be a difficult one. Every day of the year must be utilized to the best advantage if this amount of construction is to be even approximated.

Except in the southern part of the United States it will be impracticable to begin road construction and reconstruction for ten or twelve weeks yet; but this does not mean that nothing can be done. A great deal can be done, and those who realize this and get busy now will get more and better work done than those who do not.

The year's work should be planned, surveys made, specifications completed, contracts let, new machinery purchased and old put in good condition, and engineers, inspectors, foremen and other members of the force necessary for supervising the work should be arranged for at the earliest possible date.

Machinery, contractors, men and materials will be in great demand and it is probable that those who do not get these early will have to take the "leavings"—if there are any.

It is anticipated that the obtaining of materials will be an especially serious problem. It has been estimated that 120 million tons of road materials (mostly stone, gravel and sand) will be needed to carry out the program. The railroads can not possibly carry this amount during the working season.

To relieve the situation, hauling should begin at once; and this not only to save time. Most of the material will have to be distributed by teams or trucks, and in the spring the condition of most unimproved roads is the worst of the year for heavy hauling. Before the frost comes out, two tons can be hauled with the same equipment that would find difficulty in hauling one ton during the weeks of early spring. Getting the materials distributed now will save both time and money. Moreover, teams are more readily obtainable now than they will be when farming begins.

It may be possible to reduce the length of haul by locating or developing additional sources of supply. If the highway officials of every state, county and town would investigate for deposits of suitable rock, gravel and sand within their boundaries, and arrange for beginning the working of them at once, many of them could undoubtedly greatly reduce the transportation charges on materials for their roads, even eliminating the railroad haul entirely in many cases by hauling by motor trucks directly from quarry, stone crusher, or bank to the job.

As we have suggested before, the delivery of materials can be begun at once if the public authorities will purchase them direct and turn them over to the contractors with whom arrangements may be made later for doing the work. This has been done already by officials in some states.

The states and counties which, when the working season begins, have on hand, at the sites of the proposed jobs, a considerable percentage of the materials needed for those jobs, will have taken a long and important step toward completing their year's program.

Garbage Disposal in Chicago

The Bureau of Waste Disposal of the Department of Public Works of Chicago, according to the latest report of the general foreman in charge, L. F. King, that for the year 1918, disposed of 84,974 tons of garbage, which was 15.1 per cent less than in 1917. This was treated at the municipal reduction plant and produced 3,198,177 pounds of grease, which sold at an average of 11.41 cents per pound; and 15,780.1 tons of tankage, which sold at an average of $12.43 per ton.

The total receipts from products of the plant were $535,538.59, of which $10,142.15 was for rags, tin cans, bones, animal grease, hides and miscellaneous scrap. In addition, the inventory of products on hand at the end of the year was $36,910.32 greater than the year previous; giving a total credit of $572,448.91 against an operating expense of $489,500. This operating profit of $82,878.91 is the first in the history of the plant. The expenditures referred to include salaries and wages, $259,818; fuel oil, $86,500; power and light, $14,801; coal, $34,673, and supplies and repairs, $93,778. Nothing is included for depreciation, interest and overhead generally. In 1917 there had been a loss of $31,011.69 on operation alone, and in 1916 a loss of $75,948.85, thus showing increasing deficit.

The method of selling the products of the plant by contract, after advertising, resulted in securing less revenue than would have been secured by selling them from day to day or week to week, according to market conditions. Since November 1, 1918, the City Council permitted the bureau to sell the products in the open market. The contract method was unsatisfactory because "the contractors have invariably raised disputes and failed to pay for all of the products delivered. By selling in the open market the city of Chicago will at all times receive the prevailing market price and immediate payment for its products, and thus legal controversies will be avoided."

In addition to the reduction plant, the bureau operated an incinerator at which was burned 15,496 tons of South Water street refuse.

The amounts of garbage received, totaled by months, varied from 2,388 tons in January to 10,079 tons in August; but only January and February fell below 6,000 tons. In 1917, May was the month of lowest record, no other month being below 5,900 tons.

While the amount of garbage received in 1918 was 15.1 per cent less than in 1917, the amount of grease recovered was 20½ per cent less. The amount received from sale of grease, however, was 21 per cent greater, and the receipts from tankage were 32 per cent greater although the amount was about 30 per cent less.

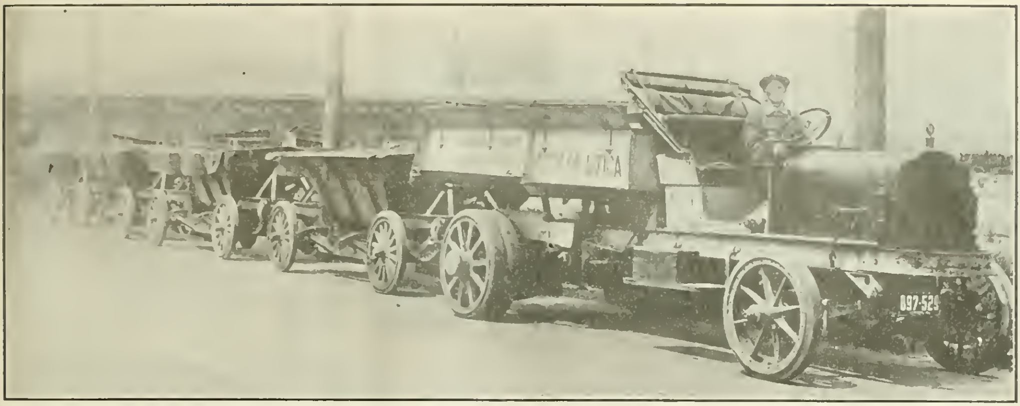
The costs of operating the reduction plant, per ton of raw garbage, averaged $3.057 for salaries and wages; $1.018 for fuel oil; $0.174 for power and light; $0.408 for coal, and $1.104 for supplies and repairs.

The prices received were 11.405 cents per pound for garbage grease, 13 cents for animal grease, 25.5 cents for hides, from $10 to $16.85 per ton for tankage, $4 for tankage unmilled and degreased, $4.50 for that remilled and reloaded, and $2 for tankage screened and reloaded. Tin cans brought $2 per ton, rags $9, bones $20, metals from $2 to $9.

Sewage Works Manager a Healthy Vocation

Theoretically we suppose the vocation of the Sewage Works Manager should, on account of working and residing in the midst of noxious smells, be an unhealthy one. But Sewage Works Managers and their wives and families are about as healthy a class of people as can be found, and their sickness and death rates are low. At the annual gathering of Sewage Works Managers in London last week it was difficult to find an individual who was not in remarkably robust health. It is interesting, too, to notice how the affinity for the work runs in families. Sons commonly follow in the footsteps of their fathers, and several brothers occupy similar positions. Probably the most interesting illustration is that of the family of Messrs. Ledson Brothers, four of whom are Sewage Works Managers in different towns, viz., Mr. Henry Ledson (Rochdale), Mr. D. Ledson, (Sewage Works, Leigh, Lancs.), Mr. Thos. Ledson (Swinton, near Manchester), and Mr. E. Ledson (Walton Farm, Liverpool Corporation). They are, moreover, all enthusiastic workers, and devoted, as is so general with Sewage Works Managers, to their work.

Municipal Engineering & The Sanitary Record, England.



TRACTOR AND FOUR TRAILERS HAULING REFUSE IN UTICA, N. Y.

Garbage Collection by Trailer and Tractor

Using this method three or four trailers are drawn by horses while collecting, and are then coupled up to form a train and hauled by tractor to the point of disposal. In this article Stanley E. Bates explains how to calculate how many trailers, tractors, horses and men can be used to the best advantage, and the cost of the service, giving illustrations of making such calculations.

The following remarks and calculations relative to the collecting and transporting of garbage or ashes by the use of trailers and tractor were prepared by Stanley E. Bates, Assoc. M. A. S. C. E., vice-president of the Lee Loader & Body Co., to give advice on a special case, but the ideas and figures contained seem to afford so much information that should be of value to municipal officials engaged in this work that we are reproducing the discussion, with only minor changes in the arrangement and omissions of unessential matter.

It seems to have been generally agreed that in most cases it is not economical to use motor trucks for collecting either ashes or garbage, owing chiefly to the numerous stops and low velocities. On the other hand, it seems more economical to use motor vehicles for long hauls of garbage or ashes after collection in transporting them to the point of disposal. The tractor-trailer system has been developed and has been tried out by several municipalities in an effort to combine the advantages of both motor traction and horse draft in this service.

A necessary preliminary to designing a system of collecting garbage or ashes is to determine the amount which must be collected in each section of the city, the frequency of collection and the length of haul from the several collection areas to the point of disposal. Unit costs of teams, labor, motor truck service, etc., including all items such as overhead, depreciation, etc., should be ascertained for use in the calculation.

THE TRACTOR-TRAILER PLAN OF COLLECTION.

The ordinary method of collection by tractor and trailers may be described briefly as follows: The trailers are drawn by horses while picking up the garbage or ashes. This is because of the frequency of the stops and also because a trailer will not ordinarily travel more than ten miles a day while collecting, which small mileage is usually uneconomical for truck operation.

The collection routes are so laid out that the three or more trailers composing one unit will meet at a certain previously determined point when they have collected their loads. At this point the horses are unhitched from the trailers and a certain number, usually three, are fastened together in the form of a train. A tractor is coupled to this train and pulls it to the dump, incinerator, or pig farm, as the case may be. Meantime, each team of horses is hitched to an empty trailer and the three empties start out collecting material in the next sections of the town, which also have been so laid out that, when filled, the trailers will again meet at another predetermined point. Here again the tractor, returning with the empty trailers, exchanges these for the loaded ones and the process is repeated continuously.

Thus operated, an operating unit consists of one tractor, six trailers, three teams of horses, three drivers, a chauffeur and the necessary helpers. There must be enough of these operating units to take care of the entire amount of garbage or ashes produced in the city, with the frequency of collection previously determined upon.

Such a unit may be considered as an average, but sometimes a tractor can pull four trailers, as is done in Utica, N. Y., while in other cases only two trailers can be drawn on account of hills or poor condition of the roads. The size of the tractor's motor, of course, determines how much the tractor will pull.

ILLUSTRATIONS OF OPERATION.

In the illustrations given below it is assumed that the tractor is strong enough and grades level enough to permit satisfactory service from an operating unit of one tractor and six trailers (three to a train) or its equivalent.

Illustration No. 1.—Assume a 4-mile haul, 2 miles to the dump and 2 miles back. In this case time estimates are as follows:

Coupling and uncoupling trains	10 minutes
Running, at 8 miles per hour	15 minutes
Dumping three trailers	6 minutes
Returning from dump, at 10 miles per hour	12 minutes
Total time per trip of tractor	43 minutes

These are believed to be conservative figures. If the men work well they can couple and uncouple in 2 minutes instead of 10, and can dump the three bodies in 2 minutes instead of 6. Furthermore, a 5-ton tractor is ordinarily governed to run at 14 miles per hour, but the running time is given as 8 miles per hour loaded and 10 miles light to allow for possible delays.

If it takes 43 minutes for each trip of the tractor, then the tractor could make 11 trips a day. If it hauls three 2½-ton trailers with 3½-cubic yard dump bodies, it will haul in a day of eight hours 82½ tons or 115½ cubic yards.

According to these figures, 33 minutes is allowed for the team drivers and lifters to fill three trailers with material while the tractor with the other three trailers is away at the dump. This brings up the third important point governing the number of tractors and trailers required by any city—the time required for collection. This will vary widely in different cities, some of the factors being the following: (1) Whether receptacles have to be carried from the cellars or back yards or whether they are placed conveniently for the pick-up men in the alley or on the street curb. (2) Whether receptacles are provided for all materials or whether some have to be shoveled up into the bodies. (3) Whether receptacles are of small size or of such a large size that two men are required to lift them. (4) Whether the houses or apartment buildings are close together or far apart; in other words, the density of population. If the population is very dense, collection will be faster than if it is sparse.

Experience in Indianapolis shows that a team driver and one lifter will fill a 3½-yard body on a trailer with ashes in 30 minutes. The Indianapolis trailers are filled very full, the load being crowned up in many cases to such an extent that 5½ yards are placed in 3½-yard bodies.

A trailer crew of one team driver and one lifter is very satisfactory, but other combinations are possible. For example, if a haul were shorter than 2 miles, so that the tractor would return with the empty trailers in less than 33 minutes, it would be advisable to have two lifters instead of one; while perhaps some cases might justify three lifters, but this is doubtful. On the other hand, if the haul were longer, it might be possible to get along without any lifter at all, the driver doing all the work. This, however, would be possible only if there were no large and heavy cans to be lifted and dumped into the trailer.

Illustration No. 2.—Assume a haul of 20 miles in the round trip. In this case the time figures would be as follows:

Coupling and uncoupling of trains	10 minutes
Running to dump, 10 miles at 8 miles per hour	75 minutes
Dumping three trailers	6 minutes
Returning, at 10 miles per hour	60 minutes
Total time per trip of tractor	2 hours 31 minutes

In this case the time the tractor is away is very much greater than that necessary for filling the trailers. It might be advisable to have only one team of horses, one driver and one lifter to take care of all three trailers, instead of one of each for each trailer. In that case the team would be hitched to one empty trailer, leaving the others on the street; when the first trailer had been filled it would return to the point where it started, and the team would then be hitched to the second trailer,

COLLECTING REFUSE IN HORSE-DRAWN TRAILER, UTICA, N. Y.

another route collected and then a third route with the third trailer.

If it required only thirty minutes or so to fill each trailer, even then the horses and men would have about an hour to wait before the truck returned with the empty trailers. But, in spite of this wait, this system might be more economical than any other that could be devised. However, there are other possible alternatives. For example, the operating unit might consist of two tractors and nine trailers. In which case the operation would be as follows:

DUMPING REFUSE FROM TRAILERS, UTICA, N. Y.

Illustration No. 3.—While tractor A is making its first trip with loaded trailers 1, 2 and 3, trailers 4, 5 and 6 are making collections. Meantime, tractor B returns from the dump with empty trailers 7, 8 and 9 and starts back with loaded trailers 4, 5 and 6, while trailers 7, 8 and 9 at once start out to collect material. Tractor A returns with empty trailers 1, 2 and 3 and exchanges them for loaded trailers 7, 8 and 9, trailers 1, 2 and 3 starting out to collect, thus completing the first cycle.

The time study would be the same as above except that, instead of the drivers and lifters having 2 hours and 21 minutes to fill three trailers, there would be only 1 hour and 10½ minutes to do this work. In this case, also, it might be possible to operate the trailers with one team of horses and one driver with no lifter.

Another possibility would be an operating unit consisting of three tractors and twelve trailers. The cycle would be similar to that above, there being nine trailers always on the road to or from the dump and three trailers collecting. In this case nine trailers are filled in the time which it takes a tractor to remove and return three trailers.

ESTIMATING COST.

On the basis of a discussion similar to the above, it is possible to determine the number of trailers required, number of tractors, number of teams, chauffeurs, team drivers and lifters, the number of miles traveled per day by tractor, by teams and by trailers. These figures having been ascertained, it is possible to calculate the cost per day or per week or per month of each operating unit and of the total number of operating units used by the city.

In addition to the chauffeurs, team drivers and lifters, it will be necessary to have two helpers riding on the tractor-trailer train to assist the chauffeur in coupling up the trailers, dumping the bodies, etc.; a man at each dump; a barn boss and perhaps assistants, depending on the number of horses that are stabled, and one or more mechanics for making repairs to tractors and trailers. (The last should not be included again in the cost of repairs to tractors and trailers referred to later on in the calculation.)

In addition to the above employes, there will probably be inspectors, clerks, stenographers, superintendents and other members of the organization, these being practically the same as would be used under any system of collection. The cost of these can generally be determined from past records. If it is merely desired to calculate the difference in cost between present methods and the tractor-trailer method, these items can be eliminated entirely, as they would be the same for both methods.

Knowing the miles traveled per day by the tractor, the cost of gasoline can be estimated at 2 miles per gallon, and the oil consumption at 1 gallon per tractor per day.

Interest should be calculated on the investment, including the total cost of the original equipment, at current interest rates; the equipment including tractors, trailers, horses, harness, horse-poles and all miscellaneous equipment.

Depreciation of the tractor should be figured on its original cost less the cost of the tires, the tire depreciation being figured separately. It is customary to assume that the tractor will run 100,000 miles before being scrapped. Knowing the average number of miles run per day, the daily charge for depreciation can be figured.

Depreciation on trailers is figured in exactly the same way, but the distance run is not so great. It is logical to figure that the trailers depreciate only when being hauled by the tractors, neglecting the distance they are hauled by teams, since this hauling is done at very slow speed.

Repairs at best can be only a guess. If the city has operated a 5-ton truck, figures of previous costs of such trucks can be used. If such figures are not available, assume $1.50 a day per truck, which is quite safe. It is believed that 50 cents a day is ample allowance for repairs to trailers.

Depreciation on tractor tires is obtained by dividing the cost of a new set of tires by their guaranteed mileage, obtaining the cost per mile, and multiplying this by the number of miles traveled per day, which will give the tire depreciation per day. This is a safe figure, as tires should last longer than their guarantee.

Depreciation on trailer tires is figured in the same way, but using twice the guaranteed mileage. Experience shows that this is a safe assumption, because trailer tires do not wear out nearly so fast as truck tires, there being no driving wheels and therefore less abrasion. Moreover, while the trailers are being hauled by horses they travel at a very low speed. Many trailer tires last three times their guarantee.

In figuring the cost and upkeep of the horses, a team of 1,400-pound horses should be considered for hauling a 2½-ton trailer. Unless the town is very hilly, horses of this weight are heavy enough to stand the work six days a week, since pick-up work is not especially heavy, the trailers are on roller bearings and are therefore easier to pull than wagons with plain bearings, the horses probably will not have to travel more than 10 or at most 15 miles per day, and they will never pull a full load more than a few hundred feet, their average load being only a half load because the trailer is empty when it starts. Local figures can usually be obtained for the cost of a horse. In Chicago a 1,400-pound horse costs from $200 to $250, but this may not hold for other cities.

The working life of a horse pulling trailers of this kind can safely be taken at from six to eight years, which gives a basis for figuring interest and depreciation on the investment. The harness for a team will cost about $100 and last as long as the team itself. Repairs to the harness will be a very small item; if figures are unobtainable, this item can perhaps be neglected.

Each horse will require on the average the following per day: ¼ bushel of oats, ¾ pound of bran, 20 pounds of hay, 1-10 barrel of shavings for bedding. Local unit prices of these items can be obtained at any feed store.

In addition to the above, each horse will need shoeing at least once a month, which will cost not to exceed $5.00. There will be other small items which can be grouped under the heading of veterinary services, which 10 cents per day per horse should cover. A study of local conditions will show what amount should be charged for rent of garage and stable.

Unless the installation is very small, extra equipment will be necessary to prevent interruption in operation. If the installation is large enough to require ten tractors, it will perhaps be necessary to have an extra tractor to take the place of one which may be laid up from time to time for repairs. For the same reason an extra trailer should be provided for every twenty needed for continuous use. The same applies to horses, but the ratio might be as low as one to six, because a horse must be laid off at intervals to be shod if for no other purpose.

STREET GRADES.

Throughout the above discussion it is assumed that the city in question does not have long grades of more than 5 or 6 per cent. But even if long grades do exceed this slope, it does not necessarily mean that the tractor-trailer system of collection cannot be used. The writer recently visited a city the main portion of which was quite hilly, but the surrounding country reasonably flat. Garbage was to be disposed of at a pig farm located about 10 miles from the city limits. It was suggested tentatively that if the tractors could not haul three loaded trailers up the grades found within the city limits, they could haul one or two at a time up to a central collecting point at the edge of the town on the road to the pig farm, this collecting point being just past the last steep grade. At this point the trailers would be combined into trains of three or four and hauled the 10 level miles to the pig farm with economy.

Water Meters Recommended for St. Louis.

In his 1919 annual report, Edward E. Wall, water commissioner of St. Louis, recommends the installation of water meters at once to permit postponing an addition to the pumping-plant and pipe system. The average daily consumption for the past year was 100,000,000 gallons, or 128.5 gallons per capita; 60 per cent of which is pumped from Bissell's Point through mains which cannot carry more than 65,000,000 gallons a day without an excessive friction loss of more than 70 feet head.

Should meters be installed and the consumption be reduced to 90,000,000, the present pumping capacity would be sufficient until 1930 or longer. "The reduction in consumption which would undoubtedly be brought about by metering all services would not only postpone for ten or twelve years the necessity for construction of new water works at an estimated cost of $12,000,000, but would also distribute the cost of extensions and improvements necessary to bring the existing works to their ultimate capacity, over an additional period of ten year, resulting in a total net saving of at least $5,000,000 to the city of St. Louis.

"Should the proposition to begin the general installation of meters this year be rejected, then the scheme of building new water works on the Missouri river should be at once taken up by the Board of Public Service."

Comparison of High Duty and Centrifugal Pumps

In planning for increasing the pumping capacity of the St. Louis water works, L. A. Day calculated the comparative cost, under local conditions, of triple-expansion fly-wheel pumps and turbine-driven centrifugal, and decided that the former would be the cheaper. His calculation is given in this article.

The pumping plant at the Bissell's Point station of the St. Louis water works will need to be increased in capacity, and in studying the problem, L. A. Day, engineer in charge of the Operating Section, made a comparison between the triple-expansion crank and fly-wheel type of pump and the turbine-driven centrifugal type. His comparison is given below.

The total charges per year would comprise annuity or sinking fund, interest, repairs and maintenance, and the cost of producing steam (labor and materials). Three combinations of pumping units were considered, each of which would produce 130 million gallons additional capacity. These combinations were: 20, 20, 30, 30, 30, m.g.d.; 30, 20, 30, 20, 30 m.g.d.; 40, 40, 20, 30 m.g.d.

The costs of the respective units were taken as follows, these including $1,000 for the foundation of each triple expansion pump and $3,000 for the foundation of each centrifugal pump:

20 m.g.d.—triple expansion, $261,000; centrifugal, $73,000
30 m.g.d.—triple expansion, 292,000; centrifugal, 85,000
40 m.g.d.—triple expansion, 306,000; centrifugal, 103,000

To determine the steam consumptions, the maximum duties were taken as follows:

20 m.g.d., Triple............200 mil. ft. lbs. per 1,000 lbs. steam.
30 m.g.d., Triple............206 mil. ft. lbs. per 1,000 lbs. steam.
40 m.g.d., Triple............206 mil. ft. lbs. per 1,000 lbs. steam.

20 m.g.d., Centrifugal.......145 mil. ft. lbs. per 1,000 lbs. steam.
30 m.g.d., Centrifugal.......153 mil. ft. lbs. per 1,000 lbs. steam.
40 m.g.d., Centrifugal.......160 mil. ft. lbs. per 1,000 lbs. steam.

The engines at Bissell's Point operate normally at 90 per cent rating; accordingly all economic comparisons are made at 90 per cent rating. From tests, the duties at this rating are, for the triples 98.5 per cent, and for the centrifugals 97.5 per cent of the maximum duties.

All comparisons were reduced to a common period of 35 years, the assumed life of a triple expansion pump. The running time of the pumps over this period was determined from the ratios of consumptions to normal pumping capacities, assuming all pumps to run in rotation and for equal periods of time. For the Bissell's Point service, which is on a reservoir, the pumps always run at normal rating, making the load distribution proportionate to the running periods. The average running hours per year, thus determined are:

for the first installed 20 m.g.d. pump, 6,200 hours,
for the first installed 30 m.g.d. pump, 6,300 hours,
for the first installed 40 m.g.d. pump, 6,100 hours.

These values agree well with past practice.

Pumps delivering into a reservoir service have no daily peak to meet, and consequently require less total pumping capacity and have longer running hours per pump than would be required of the pumps of a closed service.

Applying the above figures results in the following table:

COST PER YEAR.

	Steam per Hour, lbs.	50c p. 1,000 lbs.	30c p. 1,000 lbs.	Repairs and Maintenance
20 m.g.d., Triple	6,670	$20,700	$12,400	$800
30 m.g.d., Triple	9,700	30,600	18,400	800
40 m.g.d., Triple	12,900	39,500	23,700	800
20 m.g.d., Centrifugal	9,280	28,800	17,300	250
30 m.g.d., Centrifugal	13,200	41,600	25,000	300
40 m.g.d., Centrifugal	16,850	51,400	30,800	350

The maximum of 50 cents, and the minimum of 30 cents, were chosen as representing the cost of producing 1,000 pounds of steam, during and previous to the war period, at the Bissell's Point station.

According to the American Water Works Association Report of Committee on Depreciation, the probable useful life of "high duty large units" is 35 to 60 years, whereas, that of "centrifugal geared" is 15 to 25 years. Assuming the minimum 35 years for the triple and the mean 20 years for the centrifugal, results in the following annual costs:

Annuity	1.36 per cent for Triple,	3.36 per cent for Centrifugal.
Interest	5.0 per cent for Triple,	5.0 per cent for Centrifugal.
Fixed Charges	6.36 per cent for Triple,	8.36 per cent for Centrifugal.

	COSTS		FIXED CHARGEES	
	Triple	1.75* x Centrifugal	Triple	Centrifugal
20 m.g.d.	$261,000	$126,000	$16,600	$10,500
30 m.g.d.	292,000	147,000	18,600	12,300
40 m.g.d.	306,000	178,000	19,500	14,900

$$^{*}\frac{35 \text{ years}}{20 \text{ years}} = 1.75; \quad 1.75 \times 70{,}000 + 3{,}000 = \$126{,}000.$$

A summary of the total charges follows:

	50c steam	30c steam
For 20 m.g.d.:		
Triple	$38,100	$29,800
Centrifugal	39,600	28,000
For 30 m.g.d.:		
Triple	$50,000	$37,800
Centrifugal	54,200	37,600
For 40 m.g.d.:		
Triple	$59,800	$44,000
Centrifugal	66,700	46,000

Assuming that the cost of steam in the future will not drop much below 40 cents per thousand pounds, it was calculated that in every case the total cost per year of the triple would be lower than that of the centrifugal of equal capacity.

The desirable pump to install is obviously the 40 m.g.d. triple, which has the lowest average cost for pumping per million gallons of water and which occupies no larger floor space than any of the others considered, thus providing the greatest capacity for the available space and postponing further the time when new building will be required. This would run the least number of average hours per year and give the longest period of relief.

Sewering War-time Housing Developments

In the previous issue were set forth the methods employed in designing and constructing sewerage systems for the several services. In this one the methods of treating the sewage are described. In the Emergency Housing Projects a modification of the Doten tank was used. At a majority of the aviation fields the Imhoff tank was used, followed by chlorine disinfection in two-thirds of them. Construction and operation details are given.

SEWAGE TREATMENT.

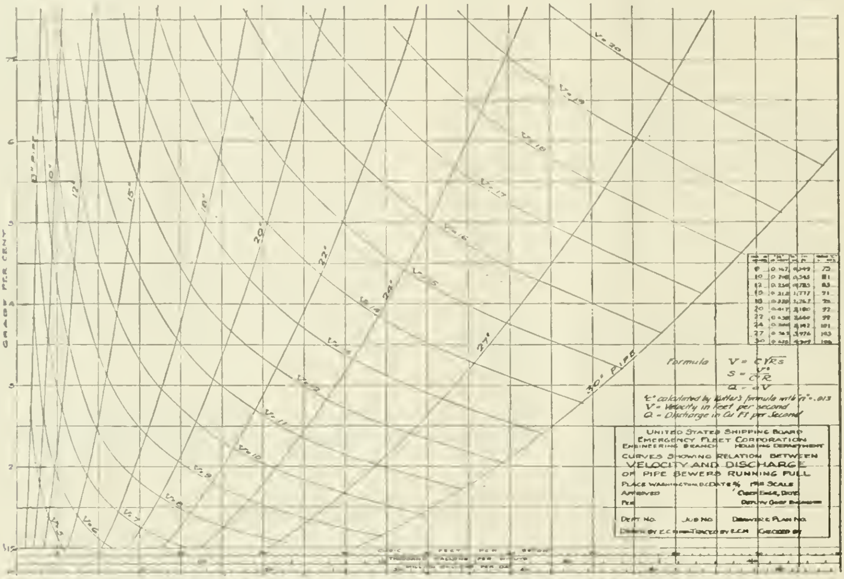
Emergency Housing Projects.—It was necessary to treat the sewage in only a few of the emergency housing projects, namely those at Hilton Village, Va., Dundall, Md., Yorkship Village, N. J., Groton, Conn., and a chlorinating plant at Port Jefferson, L. I.

The question of type of plant best suited to meet the exigencies of a war emergency was carefully considered, and it was finally determined that the requirements would best be met by a simple form of tank treatment, whereby the settleable solids might be removed from the sewage, with provision, where necessary, to properly disinfect the effluent.

In view of the fact that such works had to be constructed with the greatest possible speed, it was imperative that the type of tank adopted be one that could be built easily and quickly· This, together with the fact that simplicity of operation was important, resulted in rejecting the Imhoff type of tank . Under the most favorable conditions the Imhoff tank is not only the most expensive and difficult of all tanks to build, but it is also the most difficult to operate successfully. For small developments, where the sewage reaches the treatment works in a compartively fresh state, the use of the Imhoff type of tank was considered inadvisable. Furthermore, the Imhoff tank requires at least six months before it can be expected to operate efficiently and is never free from the danger of "frothing."

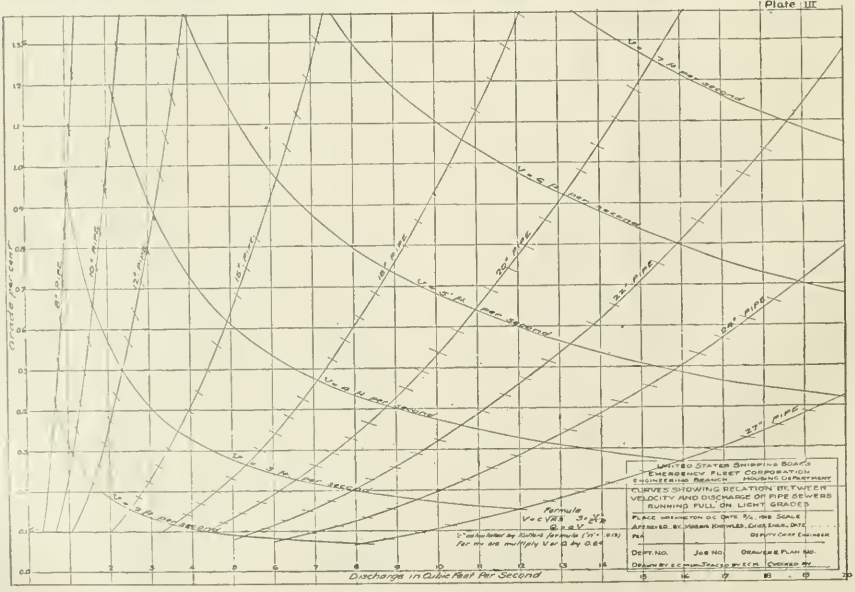
The tank recommended by Major L. S. Doten, of the Construction Division of the War Department, for use at the various army camps was studied. Major Doten, in his original design, recommended a capacity for the tank equivalent to 10 gallons per capita served. This capacity has been found inadequate and it should be at least double the original recommendation. It was originally purported that the tank would meet the requirements of sewage treatment at the army camps without any further treatment, that the sludge would be digested by septic action and that the effluent could be discharged into a stream without nuisance. The early reports relative to the operation of the Doten tank at the various cantonments were very discouraging. The department's sewage treatment expert, Geo. T. Hammond, visited many of the plants after they had been placed in operation and had an excellent opportunity to see the conditions under which they were working. He found that in most cases they were excessively overloaded and entirely too small to bear the burden placed upon them. The sewage was extremely difficult to treat, as the amount of suspended matter was unusually large and it also carried a very high percentage of fats. Much trouble was experienced from scum, caused mostly by the grease which formed about the floating solids and collected at the surface of the tank, forming a thick mat which, being removed, had to be buried in trenches to prevent nuisance. The scum was especially troublesome in the first compartment of the tank, where it developed its greatest thickness, reaching in some cases to within two feet of the top of the hoppers. The thickness of the scum decreased in the three remaining compartments, being the least in the outlet compartment. The formation of scum greatly reduced the effective cross section of the tank and the sewage passed through so rapidly that the effluent was highly putrescible and caused a nuisance.

However, Mr. Hammond was forced to conclude that



DISCHARGE AND VELOCITY OF PIPE SEWERS RUNNING FULL—HEAVY GRADES.

Plate III



DISCHARGE AND VELOCITY OF PIPE SEWERS RUNNING FULL—LIGHT GRADES.

an Imhoff tank working under the existing conditions would have given equally unfavorable results. Had arrangements been provided for properly removing the grease and had the tanks not been so excessively overloaded the results, no doubt, would have been far different.

Type of Tank Adopted.—The type of tank adopted for the developments, where treatment was considered necessary, was a modification of the so-called Doten tank. The capacity was increased to provide 20 gallons per capita served.

The tanks were designed so as to give sufficient sectional area from an elevation one foot below the bottom of the baffles, with due allowance for scum, to allow for a retention period of two hours. The tanks were usually built in parallel units. When the sludge reached an elevation of one foot below the bottom of the baffles in the first compartment the tank would be thrown out of active service and the parallel unit would then perform the functions of sedimentation, allowing the sludge in the first unit to remain in the hoppers with the expectation that septic action would develop therein and prepare the sludge for disposition on the drying beds.

In operating these tanks, it must be borne in mind that the tank is primarily for sedimentation, and very little, if any, digestion of the sludge can be effected while the tank is active. To what extent digestive action may take place during the period of rest is yet to be determined.

Care should be exercised to control any odors which arise during operation or during the period of rest. In case of odor emanating from the storage side, the sewage in the outlet compartment should be tested with litmus to determine if acid or alkaline. If acid, add a rather dilute milk of lime in the receiving chamber and pass with the sewage through the tank, allowing it to flow no longer than necessary to reduce acid condition. It will only be necessary to permit the sewage to flow for a sufficient length of time to pass the milk of lime into the first compartment. The milk of lime can be added to the second and third compartments by distribution over the surface, adding the milk of lime until an alkaline reaction is obtained. Should odor come from the surface scum, the surface scum should be sprinkled with the West disinfectant, which will reduce the odor and will kill any larvae which may be present. The West disinfectant should be mixed with the proportions of about two ounces of disinfectant per gallon of water. If the West disinfectant is not obtainable, sprinkle with saturated solution of hypochlorite (about 5 per cent) or one pound of hypochlorite to twenty pounds of water.

The odor of sulphureted hydrogen, escaping from the plant, may be controlled by placing powdered hypochlorite, about four pounds per dose in galvanized pails placed on the walls of the tank near the ventilators, the same to be renewed daily.

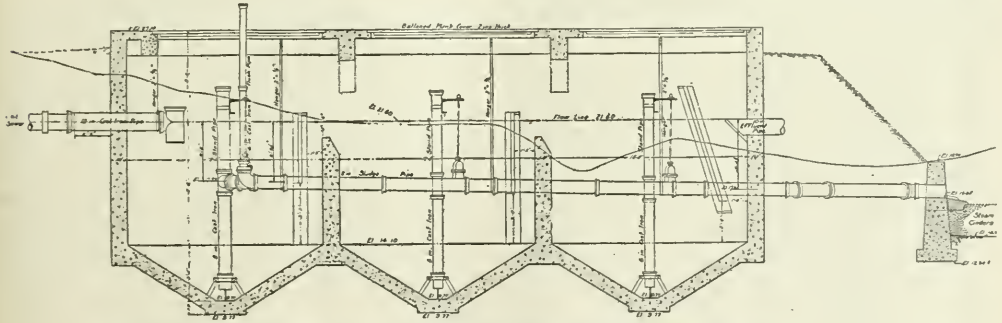
In case of odors in the operating side, the foregoing measures also should be taken.

If, at any time, odors become uncontrollable, the tanks should be cleared out, milk of lime being used and the deodorants applied.

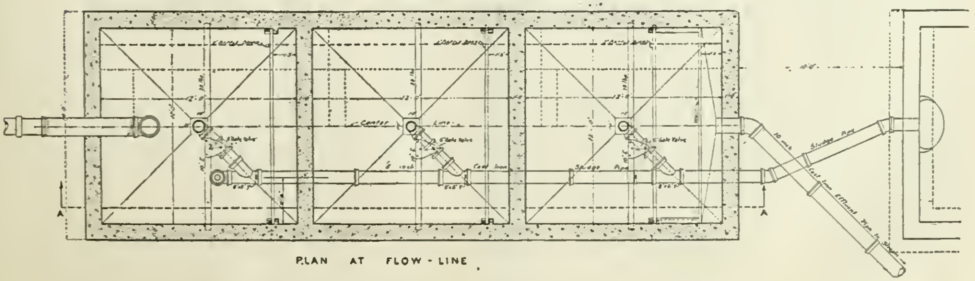
Aviation Fields.—Sewage treatment plants were also constructed at the several aviation fields and posts. Imhoff tanks were installed at eighteen of the thirty, and septic tanks at the remaining twelve. Many of the Imhoff tanks were covered with screens which greatly aided in reducing the fly nuisance. At only one field was the Doten tank installed. It did not appear necessary to provide sewage screens and detritus chambers except in connection with pumping units.

In the summer of 1918 the engineering section, supply divisions of the Department of Military Aeronautics, formulated the following general rules for the design of sewage treatment plants:

Imhoff Tanks. (a) Sedimentation chamber: flow, 87 gallons per capita; flow takes place in 16.5 hours; normal



SECTION AT LINE AA



PLAN AT FLOW - LINE

DOTEN SEWAGE TANK FOR GROTON, CONN., PROJECT.

detention period, 2 hours. (b) Sludge digestion chamber: 0.102 cubic yard per person.

Septic tanks. Normal detention period, 8 hours.

Filters. (a) Sand filters: 1200 persons per acre installed. (b) Sprinkling filters: 200,000 gallons per acre per foot effective filter depth. At 87 gallons per capita per day this equals 2300 persons per acre per foot effective filter depth. (c) Contact beds: 70.000 gallons per acre per foot effective depth. At 87 gallons per capita per day this equals 800 persons per acre per foot.

Other things being equal, we recommend the adoption of Imhoff tanks and sprinkling filters, with subsequent chlorination if deemed necessary.

Regarding per capita flow: We quote 87 gallons as being the minimum. However, if it is known that the per capita daily flow will be more than this, it should be determined as nearly as possible and be made amply large.

Minimum grades for sewers are quoted:

Size of pipe	Grade in feet per 100
6 inches	0.6
8 inches	0.4
10 inches	0.3
12 inches	0.22

Imhoff tanks versus septic tanks.—At the aviation fields the problem of the relative expense of the Imhoff tank and the Doten septic tank was not seriously considered, with the result that a majority of the plants were equipped with Imhoff tanks. In general the Imhoff tank gave a higher degree of clarification than the plain septic tank and turned out a better digested sludge.

Imhoff tanks embracing the following features gave the best results: (a) Longitudinal flow; (b) but one flowing-through or settling compartment over each sludge digestion chamber; (c) settling compartment with steep sloping sides, not less than 1:1; (d) with sufficient overlap of sides of settling compartment at slots to insure the complete deflection of the rising gas to the gas vents; (e) with retention period in the settling compartment of between 2 and 3.5 hours; (f) with sludge storage capacity sufficient to insure at least 6 months storage; (g) with gas vent area from 20 to 25 per cent of total tank area.

The relative efficiency of deep and shallow sludge digestion compartments was not determined, although shallow tanks with large sludge digestion capacity have operated as satisfactorily as the deeper ones.

Twenty of the 30 sewage treatment plants used chlorine for disinfection of the treatment plant effluent. The flow of chlorine gas, where liquid chlorine was used, was regulated in all but three or four cases by manual-control machines. It appears to be better practice, at a plant with intermittent sewage discharge due to the use of intermittent filtration units, to use a manual control chlorinator resulting in overdosing the sewage at times of low flow, rather than to experience the difficulty with an automatic control chlorinator in dosing widely varying rates of flow. The necessity of intelligent supervision and skillful operation of chlorine machines cannot be overemphasized, as chlorine apparatus is by no means fool-proof.

Sewage plant effluents were generally of as good a quality as the water of the streams into which they were discharged.

The outstanding feature of aviation water supplies and sewage disposal systems is the need for skilled operators. A skilled intelligent operator, whether he be the plant attendant or an advisory engineer, chemist or operator, who can make occasional inspections, can often obtain excellent operating results from a poorly designed plant and certainly can do so much better from a well designed one.

The engineering section of the Supply Division sent to each camp, in the fall of 1918, a set of "Instructions for the Operation of Sewage Disposal Plants at Aviation Schools." This paper included recommendations for the operation of Imhoff tanks, septic tanks, sprinkling or trickling filters, sand filters, contact beds, screens, and chlorine dosing apparatus. It also included directions in regard to measurements of sewage flow and methods of sampling and testing sewage. Such instructions undoubtedly aid in the operations of a treatment plant, but successful operation will always depend, in the final analysis, on the intelligent and careful control by a skilled operator. It may not be necessary to have this skilled operator in immediate control of the plant operation, but he must give constant advice and regular attention. The engineer section commissioned one such man to travel from plant to plant making recommendations on plant operation and also making chemical and bacterial anlyses of the sewage. The territory covered was necessarily limited because of the time required, but many advantages obtained from the use of this man were apparent.

LARCENY OF WATER, GAS AND ELECTRICITY.

By John Simpson.

> Examination of court decisions in the various states shows that these may be the subject of larceny, whether ownership is private or municipal, whether or not pipe is on consumer's premises; and that a municipality can sue for value of water and gas taken.

It is clear, from the decided cases, that water and gas in pipes may be the subject of larceny. Electricity, too, according to the only decided case in this country bearing directly on the subject, may be the subject of larceny.

LARCENY OF WATER.

With regard to the theft of water stored in pipes, the earliest of the cases on the subject is the English case of Ferens v. O'Brien (1883) 11 Q. B. D. 21, 52 L. J. Mag. Cas. 70, 31 W. R. 643, 15 Cox C. C. 332, 47 J. P. 472. In this case it appeared that a colliery, located so far away as to be out of the district supplied by a water company operating in a neighboring town, laid its own pipes for a mile to a point where the water company placed its meter. The colliery owners then put branch pipes into the houses at the colliery, to which taps were attached, allowing the workmen to take the water from the taps on paying a certain fixed sum. A woman, in spite of the warning of the manager of the colliery, took away two buckets of water from a tap within the colliery without paying for it. The justices having refused to convict, a question was stated to the court, "Is water the subject of larceny at common law?" It was held that there was nothing in the English statutes (the Waterworks Clauses Acts), containing clauses enacting penalties for the abstraction of water from a company's mains or pipes without agreement with the company, to prevent water in pipes belonging to a water company being the subject of larceny at common law. It is to be noted that the complainants here were, not the water company, but the colliery owners, who had bought and owned the water.

TAPPING OUTSIDE METER.

The most common and obvious method of illegally getting possession of water in pipes is doubtless by tapping the pipes before the water reaches the meter. A municipal corporation authorized by law to maintain waterworks and furnish water to private consumers sued a tanning company for the value of water alleged to have been wrongfully taken from the city's water mains to the amount of over 8,000,000 cubic feet during a period of eight years. The defendant demurred to the complaint on the ground that the city had no authority to sue. It was held, Milwaukee v. Herman Zoehrlant Leather Co. (1902) 114 Wis. 276, that the demurrer was properly overruled. The court said: "This is an action to recover the value of 'stolen waters.' Whether they were sweet or not does not appear, but it is distinctly charged that they are the property of the city in its mains, and that they were clandestinely appropriated by the defendant to its own use, and have never been paid for. If the water alleged to have been taken belonged to an individual or a private corporation authorized to deal in water, we apprehend there would be no question raised as to the right of recovery. The fact that the plaintiff is a municipal corporation cannot logically affect the right to recover, so long as it is endowed by law with the power to maintain waterworks and furnish water to private consumers. The water in its pipes is property, it belongs to the city, it is of some value, and it is charged to have been taken by the defendant and never paid for. This makes a complete case, on very well established legal principles." The fact that the city had established water rates and was empowered to collect them from consumers did not affect the right to recover the value of water taken in defiance of the city's regulations. That method of payment was primarily intended for water sold by the city to consumers according to its rules. Granting that it might also be used to recover for water clandestinely taken and converted, it does not exclude the previously existing common law remedy by an action for conversion.

CONNECTING ONTO NEIGHBOR'S SERVICE.

In Rex v. Hutton (1911) 24 Canadian Crim. Cas. 212, it was held, following Ferens v. O'Brien supra, that where water was deliberately taken from the pipes through which an adjoining property owner got his water supply from the city at a flat rate, after the refusal of permission from such owner and without any permission from the city, the person wrongfully appropriating the water is properly convicted on a charge alleging the theft thereof from the city. The court considered the question to whom the property was vested to be somewhat difficult, and thought, if it were a case of a meter, and the water was taken from the consumer after it had passed through the meter, it would be the property of the consumer; but where, as here, the water was supplied on a flat rate, the water was still the property of the city corporation.

BY-PASSING METER.

The most recent case on the subject of the larceny of water in pipes is Clark v. Oklahoma (1918) 14 Okla. Crim. Rep. 284,170 Pac. 275, an appeal from a judgment of conviction of petit larceny of one of the managers of an ice and fuel company by causing a pipe to be attached to a water pipe belonging to the city of New Cordell by means of which the water was diverted so that it flowed around the consumer's meter into its plant and was appropriated without payment.

The ingenious contention was made that, by reason of the provisions of the Oklahoma Statute (article 4, c. 10, Rev. Laws 1910), a city or town acquires no ownership in the water which it may impound in its pipes for the purpose of distribution to consumers, but that only a privilege is created which permits the city to acquire by condemnation, purchase, rental, lease, etc., certain lands or water districts from which a supply of water may be obtained for distribution to consumers under fixed rates or taxes, and that if a person taps the mains or pipes in which the city has impounded its waters and diverts it to a use for which the city did not intend it, or diverts it so that it would not pass through a regular meter which the city uses for the purpose of measurement, the person so diverting the water and converting it to his own use without the knowledge and consent of the city has only deprived the city of its regular charge or taxes, and is not guilty of stealing its property.

The court did not agree with this contention. The fact that the state has seen fit to permit a city or town to establish a waterworks system, and to serve the citizens with water for private consumption, charging a fixed rate for such service, does not change the water, which the city has taken into its possession and under its control by impounding it within the confines of its mains and pipes, of its character as property. That water so confined is personal property, capable of ownership, cannot be disputed. The courts have so held practically without dissent. Running water has often been compared to wild animals, bird and fishes, which, before capture and confinement, belong to no one, but after capture belong to him who captures them.

Another contention was that, after water had passed into the ice plant from the city mains, the city had no claim of ownership in it, and the defendant might use it as he chose. It was held that the facts did not support this argument. The city had contracted to supply the company with water at a certain meter rate. It had connected its main with the company's place of business by a pipe which ran through a meter, and only surrendered possession of the water to the consumer so long as it was measured in accordance with the contract. The city did not part with possession of the water until after it had passed through the meter. When the defendant, by means of the trick of placing a pipe in front of the meter to run around it and connect with the pipe behind the meter, shut off the cock in front of the meter so that water could not run through the same, he obtained possession of the city's water by fraud and stealth, and could not maintain that the city parted with the possession and ownership of its water voluntarily.

LARCENY OF GAS.

The principles applied in the above-mentioned cases relating to water have also been consistently applied in the case of gas in pipes, which at common law has always been held to be the subject of larceny. In Commonwealth v. Shaw (1862) 4 Allen (Mass.) 308, it appeared that on a consumer's failure to pay for gas, the company removed her meter and closed the service by means of a stopcock outside the house. The consumer afterwards removed the stopcock and connected the service pipe with the pipes inside the house by means of a lead pipe. The consumer was held guilty of larceny. Gas is a valuable article of merchandise, capable of being bought and sold like other personal property, of being severed from a mass of larger quantity, and transported from place to place. There is nothing in its nature which renders it incapable of being feloniously taken and carried away. The defendant severed a portion of that which was in a pipe of the company by taking it into her house and there consuming it. All this, being proved to have been done by her secretly, and with an intent to deprive the company of their property and to appropriate it to her own use, clearly constituted the crime of larceny. It was also held that the fact that the service pipe was on the consumer's premises did not constitute such an intrusting of the gas to her possession as would render the offense embezzlement and not larceny. In this the court followed Reg. v. White (1853) 3 Car. & K. (Eng.) 363, 22 L. J. Mag. Cas. 123, 6 Cox C. C. 213, 17 Jur. 536, 1 W. R. 418. In that case it appeared that the defendant owned the entrance pipe by which the gas was admitted to the meter and also the exit pipe by which it passed from the meter to his burner. Having control of the stopcock by which the gas was admitted into the meter he inserted a connecting pipe around the meter and thus appropriated gas without paying for it. It was contended that as he owned the entrance pipe he was lawfully in possession of the gas by the company's consent as soon as it entered that pipe from the gas main. It was held, however, that although the gas was in a pipe belonging to the consumer, it was still in the gas company's possession until it passed through the meter; and causing the gas to pass through the connecting pipe, thereby separating it from the gas in the entrance pipe, was a sufficient transportation, or carrying away, to sustain a conviction of larceny if the taking was with fraudulent intent.

In State v. Wellman (1885) 34 Minn. 221, N. W. 395 it appeared that after the gas company had removed its meter from a dwelling house and closed the service pipe by a stopcock, a boarder at the house connected the service pipe by means of a lead pipe he bought for the purpose with the fixtures in the house so as to use the gas without metering and without the company's knowledge.

It was held that, while the larceny would not be consummated until the final act of turning the gas on and lighting it at the burners, the person who procured the lead pipe with knowledge of its use would be equally guilty with the persons who made the connection and turned on the gas. It was no defense that the gas was taken for the use of another.

As in the case of water, in Ferens v. O'Brien, so with gas, in Reg. v. Mitchell, 22 Gas. J. 137, it was held no defense that the amount taken was insignificant, and a sentence of one month's imprisonment for larceny was imposed.

ELECTRIC CURRENT.

In United States v. Carlos (1911) 21 Philipp. 553, the Supreme Court of the Philippine Islands holds that one to whom an electric light company furnishes electric current for lighting purposes, and who, by means of a "juniper," uses electricity which does not pass through the meter installed for the purpose of measuring the current used, thus depriving the company of such electric current, is guilty of larceny.

SUMMARY OF DECISIONS.

From the reported decisions on the subject, therefore, the following conclusions may safely be arrived at: (1) That gas and water, and probably electricity, may be the subject of larceny; (2) that the fact that the owner of the article is a municipal corporation is immaterial; (3) that the theft may be from the one who purchases from the corporation supplying the commodity; (4) that the amount abstracted is immaterial; (5) that it is immaterial that the pipe from which the commodity is abstracted is on the consumer's premises; (6) that the commodity need not be taken for the taker's own use to constitute larceny; (7) that a municipal corporation has authority to sue in a civil action for the value of water or gas wrongfully taken; (8) the existence of statutes and ordinances imposing penalties for the interference with pipes and taking of gas, water and electricity does not affect the common law liability; (9) the fact that a city owning the water system collected water rates therefor is immaterial.

Blasting Down Highway Banks

Where high banks in highway cuts need to be carried or sloped back, the use of dynamite has been found advantageous in Iowa, rather than picking by hand or rooters drawn by teams. Concerning this, M. C. Potter, of Bellevue, Iowa, gives the following information:

In most cases, stumps are encountered on top of the banks and gravel or small boulders interspersed through them. The boulders and the roots make it difficult and often impossible for the teams to pull the rooters and the breaking of machinery or harness and the injury of the horses is of frequent occurance.

We have found that by putting down holes vertically in the top of the banks, locating them 3 to 5 feet back from the face and loading them with a few cartridges of dynamite (the size of the charge depending upon the depth of holes and distance back from face) much time and labor is saved. The banks are thrown down into the roadway in loosened condition ready to be loaded onto the wagons, or in shape to be drawn away in scrapers and used for fills. I have known of cases where dynamite has thrown down as much dirt, as a result of twenty minutes' work putting down and loading holes, as teams and rooters could remove in a day, and at a cost much less than team and labor hire would amount to.

Even when a steam shovel is used, we have found it to be economical to use dynamite in loosening banks because the steam shovels are enabled to operate much faster on the loosened soil.

Sewer Maintenance in Chicago

The latest annual report of Geo. E. McGrath, superintendent of the Bureau of Sewers of Chicago, shows 5,702,900 feet of sewer flushed at a cost of 61 cents per hundred feet; 379,800 feet scraped at a cost of $10.27 per hundred feet; 12,919 catch-basin cleanings by hand at an average cost of $2.98 per cleaning; and 22,505 catch-basin cleanings by machine (auto-eductor) at an average cost of $1.65. The last cost includes salaries and wages, gasoline and lubricants, repairs and miscellaneous, 10 cents a mile for depreciation and 4 per cent interest. The seven machines traveled 22,590 miles, giving $2,259 depreciation, or about 6.4 per cent.

The sewerage system comprises 3,971,308 feet of brick and concrete sewers; 9,237,997 feet of vitrified pipe; 122,985 catch-basins (less than a quarter of which were cleaned during the year); and 93,584 manholes.

The bureau maintains a system of bench marks and bench monuments throughout the city referred to city datum within the limits of precise leveling. It examines and submits to the city council all street grades and keeps public records of such grades after their establishment by ordinance. It examines all street grades contained in improvement ordinances. During the year 36.5 miles of precise levels were run, 15 standard and 12 sub-standard bench monuments built and 56 ordinary bench marks established.

The WEEK'S NEWS

May Change New York State Highway Finance Policy—Progress of Indiana Highway Commission—U. S. Public Health Service Calls Conference on National Health Conservation — Scranton Plans Street Lighting with Garbage Fuel—Boise Fire Department Issues Educational Bulletins—New York City Transit Lines Carry Two Billion Passengers—Motor Truck Regulation on Pennsylvania Highways—St. Paul Proposes City Planning.

ROADS AND PAVEMENTS

Boston Common Cut to Widen Streets.

Boston, Mass.—The "slicing" of Boston Common to permit the widening of Tremont and Boylston streets for the relief of traffic congestion was sanctioned by the voters in the municipal election. The vote stood as follows: For the widening of Tremont street: Yes, 23,414; No, 16,101. For Boylston street: Yes, 23,300; No, 15,859. Only small portion of the malls on these two sides of the Common will be thrown into the streets, each of which will thus gain a uniform width of forty-three feet. The vote was surprising, the referenda carrying all but two of the 26 wards. Four years ago there were three such propositions, embracing Tremont, Boylston and Park streets. There was very little agitation. This year Park street was eliminated, the plans for Tremont and Boylston streets were reduced to a minimum and an agreement entered into between the Boston Common Society and the city authorities by which no further invasion of the Common would be tolerated.

May Adopt "Pay-As-You-Go" Policy for Roads.

Albany, N. Y.—The state may substitute the "pay-as-you-go" plan to defray the cost of highway construction and other permanent improvements for the present system of providing for expenditures of that character through long-term bonds. Speaker Thaddeus C. Sweet of the assembly, stated that at a recent conference held to discuss the wavs and means for more highway construction, the proposal had been received with considerable favor. "Every time we float a $100,000,000 bond isue it means the expenditure of $190,000,000 before amortization," said the Speaker. "I the conference agreed with me that it would be cheaper do not know what we will do. Many of those who attended for the taxpayers urged us to pay as we go along, and we may come to that." At the conference there was much discussion on the subject. Some were in favor of the bond issue and some were in favor of including in the annual tax budgets the sum required for the construction and maintenance of state and county highways, and a larger number were in favor of a short term serial bond issue which would be a sort of a compromise between the strictly pay as you go proposition and the 30 or 50 year bond issue. Some agreed with the highway superintendents that the very expensive type of concrete pavement costing $40,00 a mile should be continued, while others favored a greater mileage and a cheaper road at less cost. Others believed that part of the state funds should be made available for building county roads under Section 320-A in the several counties. This method of construction is popular in some portions of the state. The proposed system of state and of state and county highways contains approximately 12,150 miles, of which 8,844 miles have been constructed and 3,306 miles have not yet been built. The state has heretofore authorized two bond issues of $50,000,000 each. All of this money has been spent, except $10,000,000. Commencing with 1921, the state will have no bonds with which to construct the balance of the highway system. Although, by 1920, the $100,000,000 authorized by the old bonds issues will have been exhausted, the bonds themselves will still have a quarter of a century to run and, during that whole period, the annual charge for interest and amortization on these two old issues will be $7,000,000.

Superintendent Greene's policy is to build durable roads. Former superintendent Duffy spoke at the conference in favor of cheaper roads. State superintendent Greene estimated that, aside from building new roads, it would cost $36,000,000 to put existing highways in good condition, or an average of $4,861 per mile, although the maintenance cost on a modern concrete road is not more than $75 per mile. Reasons given for present high costs were: 1. Advanced cost of labor and material; 2. Increased traffic, speed and weight; 3. Old highways not designed for modern traffic; 4. Insufficient maintenance fund in past years; 5. Virtually no reconstruction through the war years, 1917 and 1918; 6. Increased age and mileage of roads.

Work of Indiana Highway Commission.

Indianapolis, Ind.—L. H. Wright, director for the state highway commission, has prepared a review of the operations of the new state highway commission for the state fiscal year ending September 30. Detailed accounts of the commission's financial affairs, construction work, various bureaus, motor truck department and the like are contained in the report. While the period covered in the report begins in April the commission actually did not get down to business until late in May and only recently some of the departments have got under way. In writing of the work the commission has undertaken and is hoping to undertake, Mr. Wright says: "The auditor's report shows that we have under contract for construction, 133 miles of road. We had planned for the construction of at least 400 miles of hard surface road during 1920 and we have our surveys and a part of the plans and specifications worked up. But we find that the 133 miles which we have under contract will take up all of our available funds. The people throughout the state are demanding that each piece of road through their especial communities be constructed at once. The sentiment throughout the state would seem to recommend that a greater appropriation be made to this deparment in order that the system laid out may be completed in the shortest time practicable."

The report shows that the 133 miles are to be constructed at a cost of $4,739,238.36, or an average of $35,633.37 a mile. The federal government pays half the cost. A statement accompanying the report shows the total expenditures at $116,020.87, and a balance of $1,145,609.34, of which $38,541.66 is in the office and administration fund.

Itemized, the total expenditures are as follows: Administration, $7,217.86, including commissioners' and director's salary and expenses; office, $4,240,80, including bookkeepers' and stenographers' salaries general office expenses and new furniture for equipment; general engineering, $10,713.07, including salaris of engineers, expenses, new equipment and the lik; construction, $9,181.87, including contract payments on federal aid projects; inspection and construction engineering, $17,327.44, including salaries and expenses of the inspectors on federal and county aid projects; bridges, $8,627.56, including salaries and expenses of engineers; project engineering, $26,303,85, including salaries and expenses; motor transport, $27,363.74, including expenses, and $18,304 for new bodies for the skeleton trucks received as gifts from the government. The remaining $5,000 of the sum listed as total expenditures is a revolving fund for the use of the commission.

A special report covers the motor transport department and shows the lending to eighteen state institutions or departments of 58 trucks; the renting to eight contractors of 31 trucks; the number of trucks in storage and the number in use by the commission, all of which total 296. Of the thirty automobiles used by the commission itself, four were inherited from the old commission and three were obtained by trading two government trucks for them.

Graphs show the organization plan of the commission and how its various departments and bureaus are related to one another. Completed surveys by the commission include 308 miles of road. Completed plans and specifications cover 192 miles. Work now under way includes surveys and specifications for approximately 300 miles.

The bridge bureau has completed plans and specifications for $39,700 worth of bridges and these plans and specifications have been approved by the federal government. Plans and specifications completed, but not yet approved, cover $71,700 worth of bridges.

The bureau of county aid shows seventeen roads built by counties and superintendents, on petition, by the bureau. The mileage was thirty-two and the estimated cost $968,780.83. Of this work the report states: "The law makes it mandatory for the commission to superintend the construction of all roads on which such inspection is asked. The law does not, however, give the commission the right to insist on adequate and proper specifications. The supervision of the commission usually is asked after the plans and specifications have been prepared and the contracts let. The commission therefore has no voice in the preparation of these plans and specifications but is expected to secure the proper construction under the specifications prepared by the county. We believe the law should be amended so as to give the commission a chance to approve the plans and specifications if it is to be asked to superintend the construction." The report concludes with the statement: "It is hoped that in the near future we will be able to establish a testing laboratory for all materials entering into road construction and such research work as may be necessary." The commission now is having much of the testing done at Purdue University.

SEWERAGE AND SANITATION

Nation-wide Conference on Health Conservation.

Washington, D. C.—In a letter sent recently by Surgeon General Blue of the United States Public Health Service to state and city health officers, to the head of the American Red Cross, the American Public Health Association, the American Medical Asociation, the National Tuberculosis Association, the International Health Commission, the National Safety Council, the American Child Hygiene Association, and other health agencies, the suggestion was made to hold a conference in Washington to consider a health program prepared by the Public Health Service. Practically all of these agencies have under consideration some plan of health conservation and unless the work can be co-ordinated and properly directed, little will be accomplished, and there will be much overlapping of effort and waste of funds. The response to the bureau's suggestion was most favorable. Accordingly a call has been issued designating January 26, 1920, as the date on which the conference will meet, and invitations have been extended to health officers, sanitarians, and representatives of important national health organizations to participate in its deliberations. According to a statement issued by the Public Health Service, "the public does not realize what has already been accomplished in the field of preventitive medicine or what can be done by carefully executed health program which is cumulative and continuous rather than spasmodic and desultory in character. In 1900 the general death rate from all causes in the registration area of the United States was 17.6; in 1917, the latest period for which figures are available, it had been reduced to 14.2. Had the 1900 death rate prevailed in 1917, there would have been in the United States, with an estimated population of 110,000,000, 374,000 more deaths than actually occurred. The record of other years leaves little room to doubt what may be done in saving life. In 1900 typhoid fever caused a death rate of 35.9 per 100,000 population. In 1917 the rate had been reduced to 13.4. Diphtheria was reduced from 43.3 to 16.5 in the same period. Tuberculosis declined from 201.9 deaths per 100,000 of population in 1900 to 146.4 in 1917. Had the 1900 rate prevailed in typhoid fever, diphtheria and tuberculosis, in 1917 these three diseases alone would have caused 115,[illegible] more deaths than actually occurred. The success of the plan will be determined largely by its direct applicability to the conditions in the different local communities, and for this reason Federal, State and local health officers must co-operate most closely in order to direct the campaign in each community and set a definite object. For instance, a southern city would be more interested in a campaign against the mosquito and malaria than it would be in Rocky Mountain spotted fever. A northern industrial city would be more interested in the control of pneumonia and respiratory diseases. All, however, have cancer, tuberculosis and venereal diseases; all would be benefited by public health nursing, medical supervision of school children, conservation of the lives of mothers and children, adequate sewage disposal, the provision of pure water and pure milk. So, while each city and rural community will have as a definite objective the most vital need in that particular place, the various health agencies will have definite objectives according to the particular problem they set for themselves to solve. That the proposed health program of the Public Health Service is feasible is shown by the successful termination of the extra-cantonment work which was carried on so efficiently through the co-operative efforts of the American Red Cross, State and local health authorities, and the United States Public Health Service. The lesson taught by this splendid demonstration of team work should not be lost to the country. For this reason, the American Red Cross, which has set aside millions of dollars for health work in the United States, has been asked to take an active part in translating the health program into action. Its thousands of local chapters are counted on to arouse and maintain interest in health work and actively co-operate with Federal, State and local health officers in accordance with the announced policy of the American Red Cross to co-operate wtih existing health agencies."

Exclusion of School Children with Trachoma Upheld.

Bismarck, N. D.—An order of a county board of health denying admission to school of children who had, or were suspected of having, trachoma, unless they were under treatment for the disease, has been upheld by the North Dakota Supreme Court (Martin v. Craig et al., 173 N. W., 787). The plaintiff petitioned for a writ of mandamus to compel the admittance to school of two children. The defense was that reputable physicians, one of them an officer of the United States Public Health Service, had found one of the children to be affected with trachoma and suspected that the other child had the disease. Other physicians testified in behalf of the petitioner that the children did not have trachoma. It appeared that the disease was prevalent in the county, and that as a result of a survey made by the United States Public Health Service a Government hospital had been established in the county, where trachoma patients could receive free treatment. The lower court upheld the exclusion order and this action was affirmed by the appellate court. The supreme court stated in the opinion that "even conceding that it may be doubted in the instant case whether the children in question are affected, the doubt is one that must be resolved in favor of the authorities charged with the serious responsibility of preventing the spread of the disease. This is a case where mandamus does not issue as a matter of right, but where it will only issue in the exercise of a judicial discretion, and this discretion should not be exercised in a way that might result in needlessly exposing healthful children to a disease as serious as trachoma."

STREET LIGHTING AND POWER

Big Power Station for English City.

Nottingham, England.—A huge electric-power station, to cost £14,000,000 (approximately $70,000,000), will be erected on the banks of the Trent River in Nottingham, if the recommendation of a special committee appointed to investigate the matter is adopted. This announcement has just been issued by the chairman of the city's electricity committee. Some months ago the Government announced that there were to be super-power stations erected in different parts of the country, and since then the matter has been under consideration by persons interested in this particular section of the Midlands. Two well-known experts were appointed to deal with the matter from a technical standpoint, and their report was adopted at a meeting of the committee. The report advised that super-power station be erected on the banks of the Trent River at Nottingham to supply the whole area affected, which was 50 miles from north to south and 40 miles from east to west and contained 2,000 square miles, including the greater portions of the counties of Nottinghamshire, Staffordshire, Derbyshire, and Leicestershire. In this area there are 25 towns and cities each having over 10,000 inhabitants and the total number of inhabitants to be served is something like 5,000,000. It is proposed to erect the plant in two stages, the first intended to supply immediate demands and the second for rural districts later. The estimated cost of the first stage will be £5,250,000 (approximately $26,250,000), while the entire plant when completed will represent an expenditure of £14,000,000 ($70,000,000). It is claimed by the municipal authorities of Nottingham the reduction in the cost of electricity will mean a saving to the city of $200,000 per annum in the operation of the tramways alone. The site for the station will require something like 100 acres, and it is estimated that 580,000 tons of coal per annum will be required, or 1,500 tons per day. Excellent facilities are provided, both by rail and water, for getting the coal to the plant. Various schemes have been suggested for utilizing the Trent River for power purposes, but experts are unanimous in the opinion that this plan is impracticable for the reason that there is not sufficient fall to the river. The completion of the proposed plant is expected to create an immediate boom in the industrial life of Nottingham and other cities in this section, as the present electricity supply is hopelessly inadequate and too expensive. Notwithstanding the high prices prevailing, there are many industrial concerns in Nottingham which are unable to get an extension of their power, although orders were placed many months ago. With reduced prices and an adequate supply of electricity, many of the old firms of Nottingham will extend the scope of their operations, and it is believed that many new industries will be attracted to the city by the inducements to be offered.

Plan to Use Garbage as Fuel for Street Lighting.

Scranton, Pa.—The city retained Frank Koester, consulting engineer and city planning expert, New York City, to make an investigation and report regarding an entire new system for lighting all streets and some forty municipal buildings. Mr. Koester proposed to use the garbage and refuse (60 tons per day) as the bulk of the fuel required; the present maximum daily demand of the power plant is 500 k.w.; however, the plant is provided for twice this capacity. Some 1,300 nitrogen-filled tungsten lamps are to replace the present arc lamps. In addition a very extended boulevard lighting system of some 400 single lamp standards are provided for the four business sections of the city. With the exception of the underground wires in the business sections all other wires of the eleven circuits are to be overhead. The engineers' report shows that the city will save yearly some $25,000 by owning this municipal lighting system instead of renewing the contract with the local light company. A similar report was made very recently by the same engineer for the city of Allentown, Pa., where the savings affected would be $15,000 per year.

State Can Change Gas Rate, Says Court.

New York, N. Y.—The Appellate Division of the Supreme Court has handed down a decision declaring the courts had the power to decide whether the statutory rate for gas was unconstitutional because it was confiscatory, and, having so decided, the rate to be charged could be fixed by the Public Service Commission. The decision was in the suit of the Bronx Gas and Electric Company, which applied to the courts to permit it to charge more than the statutory charge of $1 a thousand cubic feet. Terence Farley, counsel to the Public Service Commission, said that the decision of the court was a victory for the commission. He explained that the company sought permission to increase the rate as it pleased, or to have the court fix it on representations by the company. The commission, by its intervention through demurrers and other legal steps, had sustained its right to fix rates, he said. "The company," he explained, "will proceed with its action in the courts. If it is found that the company's statement of its financial situation is correct the result will be a decision to the effect that the statutory rate is confiscatory and therefore unconstitutional. The result of such a decision would be that the company would have to apply to the commission for an increase, and the commission, after a public inquiry, would have the power to fix a rate that would be fair." The order of the court reversed a decision of Justice McAvoy, who decided against a motion of the company to dismiss a demurrer by the Public Service Commission covering certain points in the company's complaint. Several other gas companies have similar suits pending in the State and Federal Courts. If the opinion of the Appellate Court stands, it will affect all of them similarly. The Appelate Division has also denied an application of the Brooklyn Gas Company to vacate a stay obtained by the Public Service Commission preventing the company from charging more than $1.10 per thousand cubic feet for gas. It was said that it would require a charge of $1.30 to meet operating costs.

FIRE AND POLICE

Fire Department to Issue Educational Bulletins.

Boise, Idaho.—For several years the fire department of this city has endeavored to disseminate information and warnings relative to the conditions which tend to create or spread fires. This has been limited to the inspection of business establishments and the medium of the public press. The results from these sources have been gratifying, but the chief of the fire department, W. A. Foster, will soon inaugurate a novel improvement of this service. It is proposed to issue bulletins at regular intervals, probably once each month, in which will be indicated some of the fire hazards prevalent at that particular time of year. In addition to the warnings the bulletins will often contain information concerning other hazards and instruction as to how they may be eliminated or reduced. In order to make practical such a service, citizens are requested to furnish names and addresses from which a mailing list may be made up to receive the bulletins free.

Organizing for Two Platoon Plan.

Somerville, Mass.—Chief Rich, of the fire department, has completed his plans for operating on a two-platoon program which was approved by the voters at the recent election.

When the two platoon system for the Somerville fire department goes into effect, 90 days hence, a fireman will have his breakfast at home and report at the fire station where he is employed at 8 a. m. He will either bring his lunch with him or some one will take it to him at noon, for he cannot leave the station, except in the performance of his duty, until 6 p. m. He has his supper after going off duty.

The second day the program is the same, and yet again on the third day, until 6 o'clock. Instead of going off duty then and returning to his home, the fireman eats a supper that some one brings him and keeps right on with the performance of his duty until 8 o'clock the next morning. Then he goes home and gets his breakfast.

He reports for duty that night, the fourth day, at 6 o'clock, having first fortified himself with his supper, and remains at the station until 8 the following morning. Again, on the sixth day he does the same, but when he goes off duty the following morning he stays away from the station for 24 hours, that time being all his own.

During the 24 hours off duty the fireman may leave the city, that being his day off, which comes then once in six days instead of once in five days, as now. At any other time than his day off he must respond to all multiple alarms, that is a second, third or general alarm.

The routine of one fireman is like that of all the rest. When he is off duty another man takes his place, and when he is on duty the other man has his time to himself.

The department is divided into two equal parts, under the law for the two-platoon system, which work alternately day and night, but the two sections, or platoons, as they are called, alternate every three days instead of continuing regularly day and night.

If all the men of the fire department went to work under the two-platoon system on the same day, there would be only half of the department available on the sixth day. To prevent that condition from occurring, chief Rich has planned to start a fourth of the men on the first day, another fourth on the second day, the third fourth on the fourth day, and the last fourth on the fifth day, thereby distributing the minimum strength over a period of days.

The only exception will be in vacation, which the two-platoon system does not take into account. Extra men will have to be employed then, as now.

Under the old conditions the men were on duty continuously for four days of 24 hours each, with the exception of meal times, and then have the fifth day as time off. Their meal time amounts to three hours and a half a day, an hour for breakfast and an hour and a quarter each for dinner and supper.

Obviously the men are not all able to go at the same time to any meal, and are divided into three shifts for each. Between 6.30 a. m., when the first shift starts for breakfast, and 8 p. m., when the last detail gets back from supper ,there is an aggregate period of ten hours and a half during which the department is at hardly more than skeleton strength, having but 44 men available at most.

The present strength of the department consists of 82 men. Of that number one-fifth, or 16 men, are away each day on leave. Of the 66 men remaining, one-third, or 22 are away at the same time to any one meal.

The department is, therefore, at it's weakest between 6.30 and 9.30 a. m., between 11 a. m. and 2.45 p. m., and between 4.45 and 8 p. m. The morning and evening periods are apt to be those of a considerable number of fires. The department is at its maximum strength between 8 p. m. and 6.30 a. m., when, from some aspects, at least, there is the least need of it.

Under the two-platoon system these conditions will be changed. Chief Rich has figured that at least 30 more men will be needed to augment the force sufficiently to make one-half of it a properly effective working organization. Under the two-platoon system there will be 56 men on duty all the time, with half of that number available as a reserve force two-thirds of the time, and an equal number the other third of the time, if anything more than a one-alarm fire happens. At the present rate of pay, the 30 extra men would add $36,000 to the expenses of the department.

Increased Pay for Policemen.

Northampton, Mass.—The common council has taken favorable action on the petition of the policemen for an increase in salary. This petition was acted on at the last meeting by the Board of Aldermen who favored the increase. The salaries of the police department according to the increase will be as follows: Chief, $2,372; captain, $2,190; sergeant, $2,007; first-year men, $1,358; second-year men, $1,642; third-year men and thereafter, $1,825—on condition that the police do not ask for another raise for five years. Capt. Lyons of the police force has stated the officers would give a written agreement if desired. It was decided not to require this, but to take the word of the men.

TRAFFIC AND TRANSPORTATION

Two Billion Rides a Year on New York Transit Lines.

New York, N. Y.—Statisticians of the Public Service Commission have just completed a compilation of figures showing the traffic on the transportation lines of the city during the last fiscal year, the variation in the traffic for the different months due to epidemics and other causes, and the increase in traffic over the preceding year. Based on the number of fares collected the figures show that during the year 2,079,942,004 passengers rode on the lines, an increase of 104,430,015 over 1918. A statement by the commission says: "The almost unprecedented growth in traffic for 1919 was in spite of the ravages of the influenza epidemic during the Autumn months of 1918, which caused a falling off in October alone of more than 12,000,000 fares, and for the period of July to November inclusive of 1918, of 17,000,000 fares." The report shows that the total increase of approximately 104,500,000 was divided between the various lines as follows: Rapid transit lines, 98,751,618; surface lines, 5,679,197. On the basis of percentages the total increase was 5·29 per cent., all of which went to the rapid transit lines except .65 per cent. which went to the surface lines.

Details contained in the report disclose the fact that the largest percentage of gain was won by the elevated lines of the Brooklyn Rapid Transit System, where the growth was nearly 20 per cent., which represented a total traffic of 308,879,791, or an increase of 50,712,478 over that of 1918. The heaviest traffic on any single system was on the subway lines of the Interborough Rapid Transit Company, where the grand total of passengers was 461,147,058, which represented a gain of 10.23 per cent., or 42,889,050 more than were carried in 1918.

There was a decrease of 1.27 per cent. on the Interborough elevated lines, representing a loss of 4,472,059. These elevated lines carried a total of 348,188,000 passengers during the year. Figures of the business done by the Hudson & Mahattan Company disclosed a gain for the year of 12.70 per cent., or an increase of 9,761,817 passengers in a total of 86,050,815.

Figures on traffic on the surface lines, divided among the boroughs, show that in Manhattan the total traffic was 370,085,099 passengers; a loss of 1,051,290, or .28 per cent. less than in 1918; in Bronx there was a gain of 1.11 per cent. in a total of 80, 806,261; in Brooklyn there was a gain of about one-half of 1 per cent. in a total of 362,103,192 in Queens the gain was 7.54 in a total of 3,275,369, while in Richmond the gain was 4.38 per cent. and the total was 15,958,213.

The report says that the traffic problem in the city is exemplified by the fact that since 1903, a period of sixteen years, the traffic on all of the transportation lines has more than doubled, and that the billion mark was first passed in 1903. It appears from the figures that the average traffic each day during the last fiscal year was 5,700,000, which about equals the population of the city. Toward the end of the year the daily averages of rides increased to 6,400,000. The fares per capita collected in 1860 were 43, and in 1919 the number had increased to 370 which shows, according to a comment in the report, that the habit of riding is growing steadily more popular. Then the report says: The increase of 104,430,815 passengers brought approximately $5,220,000 additional revenue to the railroad companies, which with revenue other than that gained by operation of the lines, yielded a total revenue for the year of $110,191,682, or $6,690,919 more than in 1918. Operating expenses increased greatly, however, the total of these increases being $15,267,181, which caused a deficit in net income of $8,085,819. The average cost of transporting each passenger (no allowance being made for taxes, interest, or dividends) was 3.446 cents in 1919, as against 2.293 cents in 1918, and 2.638 cents in 1914."

Motor Truck Limitations in Pennsylvania.

Harrisburg, Pa.—The question of licensing trucks having a width greater than the 90 inches fixed by law was brought up by a delegation from the Motor Truck Association of Philadelphia to the state highway commission. Commissioner Sadler explained that there can be no deviations from this phase of the act of June 30, 1919. Weight requirements as fixed in that law will also be strictly enforced; and inspectors will arrest drivers on trucks exceeding the gross-weight limit as stamped on the side of trucks. "It is not the idea of the legislature or the State Highway Department in any way to interfere with the development of truck transportation," commissioner Sadler said. "Trucks are here to stay. But we must consider them from five points of view—length, breadth, weight, lights, and the character of the person operating them. Because of the heavy trucks in use, and the foundations we must build to carry them 365 days a year, our roads are costing us $25,000 a mile more than would be necessary had we only passenger cars to contend with. We asked the legislature to set a truck weight so that we could build our roads to carry that weight. They have fixed a limit of 26,000 pounds. We are building our roads accordingly, and trucks must stay within that weight. Our regulations have all been made for the safety of the traveling public. We ask the truck owners and manufacturers to co-operate with us. The day of the road outlaw is past." "There will be 500,000 motor vehicles in Pennsylvania in 1920," said commissioner Sadler. "Possibly 50,000 will be trucks. The rights of the other 450,000 owners of cars must be protected and respected. Regulations which apply to passenger cars and to small trucks equipped with illuminating devices must apply to the larger trucks. Drivers of passenger vehicles must not be compelled to drive in fear of inconsiderate drivers who know that in a collision their large vehicles would suffer only slight damage." The representatives of the Motor Truck Association said that large trucks were not supplied with lights other than oil signal lamps on each side; and that electrical devices were not practical. "It would seem to me," said the commissioner, "that manufacturers, in view of the requirements of the Pennsylvania law, should begin to supply lights; and that their engineers should develop a practical lighting system. Here is the law; we cannot modify it." Commissioner Sadler called attention to the fact that many trucks from the cabs of which drivers are unable to see back of them are not equipped with fender or other mirrors. The law in this particular will be strictly enforced, he said; and the delegation agreed with him that it should be.

MISCELLANEOUS

St. Paul Invites City Planners to Compete.

St. Paul, Minn.—Letters to all of the best known city planning experts in America have been sent out by the City Planning commission in an effort to create competition for the position of consulting planner for St. Paul. The commission hopes to agree on an advisory city planning expert very soon. A local executive will be hired before then, it was stated. Every consideration will be shown St. Paul men who possess the requisite qualifications in the selection of a planner, members of the commission announced The commission has written to other cities which have taken up community planning, in order to get the benefit of their experience.

Interstate Park Closes Biggest Year.

New York, N.Y.—According to a report by George W. Perkins, president of the New York Commission of the Interstate Palisades Park, 621,000 people went to Bear Mountain Park; 192,000 rode on the sight-seeing buses; 400,000 went the Palisades region; 50,000 used the Park bath houses; 50,000 campers spent an average of eight consecutive days each somewhere in the Palisades Park system; over one million sales were consummated at Bear Mountain Inn. This, in part, is the record of achievement of the Palisades Interstate Park for the past summer. In issuing these figures Mr. Perkins said: "The fact that over a million people have visited the Palisades Park system during the past summer is a gratifying result of twenty years' work. There have probably been more visitors to the Palisades Interstate Park this season than there are visitors in one year to all of the national parks of the United States. The popularity of the Palisades Park lies in the fact that it is a State playground, administered by an unpaid Commission, the sole aim of which is to give the people of New York and New Jersey a chance for wholesome recreation." Over 400,000 people enjoyed free row boating at Bear Mountain. Probably no other public park in the country permits the free use of row boats. A large open-air dance pavilion with music provides wholesome dancing, under supervision, to thousands of couples every season without cost. A new development at Bear Mountain Park has been the mothers' rest station, where nurses care for children while the parents spend the day around the Park. This has been a great boon to many tired mothers, who, without such a facility, would find no respite from family cares. Over 50,000 people, mostly children, spent an average of eight consecutive days' vacation each, in the 49 group camps in the Park. Provision was made for the undernourished, the crippled, the blind, tenement mothers, working boys, working girls. There was a daily census of 1600 Boy Scouts. Although many of these camps are 17 miles from Bear Mountain, most of them were supplied with hot, cooked food from Bear Mountain Inn, sent by automobiles in heat retaining vessels. The camps are located on lakes with plenty of fishing, bathing, hiking, games and camp-fires. Approximately 9,550 of the campers were poverty cases. Over 42,000 paid from $3 to $6 for board; 30,000 were children under 14 years; 12,250 were tenement mothers or self-supporting working boys and girls. Bear Mountain Inn, operated by the Commissioners, was built for the purpose of supplying wholesome food at cost to visitors. The bathing beaches and bath houses in the Palisades region, opposite congested Manhattan, were more popular than ever this last season—over 41,000 using them. Of this number 29,366 paid from 10 to 25 cents each for bath house privilege, while 12,144 used the bath house without charge. Approximately 5000 individuals spread tents, under permit, in a tent colony north of Alpine, N. J., and at old Fort Clinton, at Bear Mountain, N. Y. Whole family groups camped here for the season. "One of the reasons the public takes such hold on the Palisades Park development," said Mr. Perkins, "is that no concessions whatever are let in the Park—the Commissioners operating the restaurants, automobiles, camping and other facilities. Owing to the tremendous increase of visitors to all sections of the Park, the Commission has under advisement a number of improvements, which will make this popular resort of even greater attractiveness and value."

LEGAL NOTES

A Summary and Notes of Recent Decisions—Rulings of Interest to Municipalities

Contract Let Without Bids—Work of Auditor

(N. J. Sup.) Act April 1, 1912 (P. L. p. 593), prohibiting the award of a contract for the doing of work or furnishing of any material or labor in excess of $500 except to the lowest responsible bidder after public advertisement, does not invalidate resolution of commissioners of a city selecting auditors of city's books for a year, as required by statute, at a compensation of $1,175, such services not constituting "work, materials, or labor."—Heston v. Atlantic City, 107 A. 820.

Tenement House Law—Rags as Inflammable Substances—Definition of "Lot."

(N. Y. Sp. Sess.) Small particles or fragments of cloth, assembled promiscuously, with extensive intervening air spaces, constitute "rags" within the meaning of the Tenement House Law, providing for protection against fire, and prohibiting storing or handling of inflammable substances.—People v. Krinka, 177 N. Y. S. 846.

The term "lot," as used in Tenement House Law, §§ 2, 38, 50, 52, 53, 54, 60, 61, 124, prohibiting the storing or handling of certain inflammable substances means property possessing certain elements of unity, such as singleness of ownership, entirety in use, separation by physical environment or community custom, and where all such elements are present, except singleness of ownership of the two parts, other circumstances, including mortgages, the relation of the owners of the parts, and recent ownership of the whole by one of them, will be held to indicate that there has been no severance which can alter the application of the Tenement Law charged to have been violated.—Id.

Negligence of City—Barriers on Retaining Walls—Injury of Pedestrian.

(Pa.) A city was grossly negligent in failing to place any barriers or guards along the retaining walls of a street running along the side of a creek from 7 to 11 feet below. —Haughney v. Mahanoy City Borough, 107 A. 843.

A pedestrian could not recover damages from a borough for injury from falling from a street over a retaining wall, which had no guards or barriers, into a creek from 7 to 11 feet below, where, though the night was dark, she was familiar with street, and had three other safer and better lighted routes, and where she testified that she did not look where she was going, and did not look for the creek, although she knew of it.—Id.

NEWS OF THE SOCIETIES

Jan. 28.—WESTERN SOCIETY OF ENGINEERS. Annual meeting, Chicago, Ill. Secretary, Edgar S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

Feb. 9-13.—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention, Louisville, Ky. Secretary, E. L. Powers, 150 Nassau street, New York.

Feb. 16-18.—INTERNATIONAL CITIES AND TOWN PLANNING ASSOCIATION. Annual meeting, London, England. Honorary secretary, C. B. Purdon, 3 Grays Inn Place, London, W. C., England.

Feb. 20-21.—AMERICAN CONCRETE PIPE ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, G. E. Warren, 210 South LaSalle street, Chicago, Ill.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

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American Road Builders' Association.

Members of the American Road Builders' Association and other highway or allied organizations, duly appointed delegates and all others interested in highway improvement have been invited to the tenth American Good Roads Congress, the seventeenth annual convention of the Association and the eleventh National Good Roads Show which will be held at the Jefferson County Armory, Louisville, Ky., February 9 to 13.

The program covering the several sessions of the congress will include the subjects of highway construction, transportation and maintenance; also the administration and financing of national, state, county and municipal highways. Papers and addresses by leading highway authorities and reports on live topics by the several committees of the American Road Builders' Association will be presented for discussion. All sessions of the Congress will be held in the Convention Hall of the Armory, one flight above the floor on which will be held the exposition of road and paving machinery, materials and methods.

The first session of the congress will be opened in the afternoon of February 9 by addresses of welcome by local, state and city officials and an address in response by the president of the association. This will be followed by the presentation of papers and reports of committees and discussions during the remaining days of the Congress. It is proposed to have moving pictures on Monday and Tuesday evenings, a reception or ball (formal) on Wednesday evening and the association dinner (informal) on Thursday evening. On Friday afternoon the members of the association will hold a business session.

Papers and discussions on the following subjects will be presented:

"Cooperation Between Engineers and Contractors in the Execution of Highway Programs."

(Copies of paper by contractor to be furnished to two engineers and two contractors, who will be asked to open discussion.)

"Modern Plant and Equipment for Highway Construction."

"Status of State Aid to Counties and its Future Development."

"Should the Township and the District Board be Abolished as a Road Construction and Maintenance Unit?"

"Is State Supervision of the Construction and Maintenance of all Highways Desirable?"

Committee report on "What Part of the Total Cost of Highway Construction and Maintenance Should the Motor Vehicle be Expected to Bear?"

"Factors which will Limit Highway Construction During the Coming Season."

(a) Car Supply and what can be done to overcome the shortage.
(b) Materials—The development of local supplies and increasing the output of existing plants.
(c) Labor—How can supply and efficiency be increased?

"The Fundamentals of Early Highway Construction and are we Neglecting Them?"

"What are the Fundamentals of Modern Highway Construction?"

"New Highway Tests Being Made by the Bureau of Public Roads."

"For What Grade of Construction Should the Federal Aid Funds be Expended?"

"New Developments in Proper Construction of and Bad Practice which Should be Eliminated in Concrete, Brick, Granite and Wood Block, Bituminous Penetration, Bituminous Mixed and Surface Treated Macadam and Gravel Pavements."

The exhibition of machinery, materials and methods which will be held on the first floor of the Armory is expected to be the most complete exposition of the kind ever held. It will embrace the various kinds of labor-saving machinery and appliances as well as materials used in the construction and maintenance of improved roads and pavements.

National Highway Traffic Association.

The annual convention of the National Highway Traffic Association will be held January 29 in the International Amphitheatre, Chicago, Ill.

At the morning session Arthur H. Blanchard, president of the association, will be chairman. The following program will be presented:

Report of committee on "Highway Transport Franchises," chairman, F. W. Fenn, secretary, Motor Truck Committee, National Automobile Chamber of Commerce.

Report of committee on "Interrelationship of Highway, Railway and Waterway Transport," chairman, Professor Henry E. Riggs, University of Michigan.

"Effect of Car Tracks on Traffic Capacity of Roadways," by George W. Tillson, consulting engineer, La Grange, Illinois.

Report of committee on "Traffic Limit Lines on Roadway Surfaces," chairman, C. W. Hubbell, city engineer of Detroit, Michigan.

Report of committee on "Sign Posting for Detours, and Through Routes in Municipalities," chairman, Elmer Thompson, secretary, The Automobile Club of America.

The afternoon session will be a joint session of Highway Transport Conference of the National Automobile Chamber of Commerce, and the National Highway Traffic Association on the subject: "Highways and Motor Transport." The chairman of session will be David Beecroft, vice-president, North Atlantic Division, National Highway Traffic Association. These papers will be read:

"Taking an Interest in Motor Truck Legislation," by Harry Meixwell, Jr., secretary, Automotive Industries Legislative Commission, New York.

"Value of Highway Transport Surveys," by F. Van Z. Lane, transportation engineer, Packard Motor Car Company.

"Interrelationship Between Highway Transport and Back-to-the-Farm Movement," by S. V. Norton, B. F. Goodrich Rubber Company.

The evening session will be a joint session of Highway Transport Conference of the National Automobile Chamber of Commerce, and the National Highway Traffic Association on the subject: "Highways and Motor Transport." The chairman will be R. C. Hargreaves, vice-president, North Central Division, National Highway Traffic Association. The following will be presented:

"Relation of Highways to Motor Truck Operating Cost," by Arthur H. Blanchard, Professor in Charge of Highway Transport, University of Michigan.

"Progress in Highway Improvement," by William G. Edens, president, Illinois Highway Improvement Association.

"Constructing Roads for Motor Truck Traffic," by T. R. Agg, Professor of Highway Engineering, Iowa State College.

"Status of Legislation Relative to Snow Removal from Inter-and Intra-State Highways," by Raymond Beck, chief, Goodrich National Touring Bureau.

Indiana Engineering Society.

The Indiana Engineering Society will hold its annual meeting January 23 and 24 at the Claypool Hotel, Indianapolis.

Prof. G. A. Young, Purdue University, Lafayette, Ind., will deliver the presidential address. The following papers will be presented:

(*Continued on page* 38)

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

LITTLEFORD PATROL HEATER.

For Heating Bituminous Materials in Highway Repair Patrolling.

A small portable heater for heating tar and other bituminous materials has recently been designed and placed on the market and has already become widely popular, particularly in those highway departments operating a patrol system.

The Littleford patrol heater is a one-man kettle with which a patrolman, covering a limited mileage, is able to make patches as soon as a road begins to show wear. The patrolman takes this gravel and can repair a crack or worn spot in almost any type of surface.

The heater is durably constructed of sheet steel, but not too heavy, and it is so designed as to be easily handled by one man. The fire box is fitted with a cast iron grate and hinged fire door. The welded kettle rests entirely within the fire box and is removable. It has a capacity of eight gallons.

The heater, which is shown in the accompanying illustration, is made by Littleford Bros.

ALLEN LOCKING DIFFERENTIAL.

For Cars, Trucks and Tractors—Gearless and Frictionless.

The Allen differential is designed to get away from the gear differential and its limitations on motive power and its possibilities for danger from skidding. The Allen differential is claimed to be the nearest approach to a solid axle of any mechanism that affords compensation yet invented. It is gearless, frictionless and self-locking. It is therefore claimed to give increased motive power, to prevent skidding and to enable a vehicle to pull through mud, snow or sand regardless of lost traction on either wheel; to save gas, tires and wear and to eliminate friction and lessen strain.

The principal of this differential is based on the proper construction and application of the pawl and internal ratchet, positively controlled. There is a ratchet ring having a splined hub for each wheel shaft (right and left hand); the pawl block carrying the driving pawls on each side for forward and reverse driving. The pawls are set in the pawl block with limited movement, and the whole is secured in the casing to which the main gear wheel is either riveted or bolted. The driving mechanism—ratchet rings, pawl block and pawls—is assembled and secured in the inner or differential casing. The pawl block driving lugs are secured in slots in the casing with a limited movement, about 3-16 of an inch, which movement automatically changes the pawls from forward to reverse drive. This makes the freedom of movement of this differential but 3-16 of an inch, and the running absolutely noisless, and without shock.

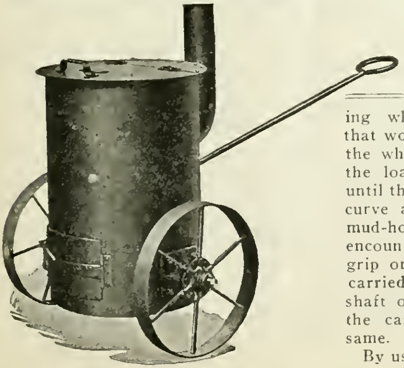
The strain on all parts of the "Allen" is of compression only; no torsion—no tension. It gives a positive two-wheel drive, and occupies the same space in the housing as the one-wheel drive gear differential.

When the mechanism is pulling both wheels, all parts move together as a unit. When one wheel travels faster than the other—as when rounding corners—there is no lead on that member; hence no wear.

When rounding corners or running circles, the wheel on the long curve overruns the driving pawls, making it a free wheel. The wheel on the short curve drives the laod. Should the driving wheel encounter any condition that would cause it to lose its traction, the wheel on the long curve picks up the load, carrying the vehicle along until the wheel on the short side of the curve again takes the pull. In case mud-holes, ice, snow, sand or slush are encountered, if either wheel can get a grip on the road, the vehicle will be carried safely through. Should a drive shaft or chain, on either side. break, the car will keep running just the same.

By using the "Allen" motive power is greatly increased because all of the power lost in operating a gear differential is saved. No power is lost through the "Allen" because there is no friction through which to lose it. Mechanical resistance against the motor is eliminated. This differential is particularly adapted for heavy service on trucks used in hauling and construction work.

The East Iron & Machine Co. is sole lessee of the Allen patents for the United States and Canada.



Littleford Patrol Heater for Road Repair.

INDUSTRIAL NEWS

Material Handling Machinery Manufacturers Association.

The Material Handling Machinery Manufacturers Association will hold an open convention at the Waldorf Astoria Hotel, New York, N. Y., for two days, January 29-30. This meeting is intended to be a "get together" two days for all manufacturers of mechanical handling machinery, accessories and equipment.

Manufacturers will be welcome from any part of the country who make cranes of any kind, hoists, winches, portable, gravity and power conveyors, industrial trucks, tractors and trailers, bulk handling machinery, elevators. motors and electrical control apparatus, batteries, ball-bearings, wire and manilla rope used in the construction of mechanical handling machinery, hand lift trucks, etc., etc. In other words, the association invites representatives of all manufacturers who make machinery or equipment for machinery which handles raw products, parts in process and finished products, by mechanical movement rather than by manual physical labor.

Details of the program are being completed and arrangements have been made to hold a morning business session on January 29, followed by a formal luncheon at the hotel with a prominent speaker, and an afternoon session, at which short papers on mechanical handling will be read, followed by open discussion and moving pictures.

The morning of January 30 will be devoted to an executive session of the membership and the afternoon will be a continuation of the papers and discussion on mechanical handling followed by a moving picture program of a number of the latest and largest installations.

Anybody interested in the art of mechanical handling, either as a manufacturer or otherwise, is invited to attend the luncheon and the meetings.

The secretary and manager of the association is Zenas W. Carter, 35 West 39th Street, New York City.

J. D. Adams & Co., Indianapolis, Ind., has ready for distribution, the new 1920 catalog which is said to be the most elaborate and most complete catalog ever published on road graders.

The complete line of Adams adjustable leaning wheel graders is shown in three colors, full descriptions of each grader are given as well as complete specifications, and the entire catalog is profusely illustrated with scenes of Adams graders in action. The principle of the leaning wheel feature of Adams Graders is also explained and illustrated in a simple and comprehensive way.

In addition to graders, the catalog lists the Adams line of road maintenance and construction machines and tools. The catalog contains 64 pages, mostly illustrations, and certainly should be of value of anyone interested in road building and maintenance equipment. It is mailed free upon request.

Pneumatic Cord Tires Allow Heavier Loads on Lighter Trucks.

That the pneumatic cord tire is working radical changes in the construction of motor trucks by permitting a much heavier pay-load to be carried on lighter weight trucks, appears from recent tests.

In experiments recently conducted by **The Goodyear Tire & Rubber Co.**, Akron, Ohio, which operates a fleet of 50 trucks in the transportation of freight and passengers, complete truck weight has been cut to 8,000 lbs, permitting a record pay-load of 7,000 lbs. The truck in question is composed of a two ton chassis, a three ton motor and 38 x 7 and 42 x 9 tires.

This development of truck transportation has already proved to the company that it can haul its own products from the factory to branch offices at a saving in freight rates. It would appear to indicate posibilities of sweeping reductions in the hauling expense of many large transportation compani that have not changed over from solids to pneumatics.

Heretofore it was supposed that pneumatics would not make any material difference in truck construction, nor was it supposed that any heavy type of truck could be equipped with less than 44 x 10 tires on the rear wheels. But the company kept close check on the performance of trucks and tires even to the extent of sending several of its express trucks on coast to coast trips.

A truck weighing 15,800 lbs, carrying a pay-load of only 3,850 lbs, was stripped to 11,800 lbs and developed a payload of 5,800. It was still considered too heavy in proportion to the load carried. A further reduction resulted in a 10,000 lb. truck with a pay-load capacity of 6,800 lbs. This was followed with the 8,000 lb. truck now carrying a load of 7,000 lbs.

It is the belief of company experts that the end is not yet in sight and that on heavier type of truck, pneumatic tires will sustain a pay-load equipment to the weight of the truck. It is not altogether impossible that eventually the pay-load will out-weigh the truck.

NEWS OF THE SOCIETIES

(Continued from page 36)

"Recent Proposals for Educating Engineers," Prof. W .K. Hatt, Purdue University; "Paper and Report on Mechanical Engineering," Prof. Frank C. Wagner, Rose Polytechnic Institute, Terre Haute, Ind. "Big Things Confronting the Engineer" (Illustrated), Prof. F. H. Newell, University of Illinois, Urbana, Ill.; "Talks by Indinaa Engineers in the Service," led by Col. W. S. Boyle, Indianapolis, Ind.; "License Law for Engineers."

"Electrically Operated Pumping Plants in Indiana," S. C. Blalock, Lafayette, Ind.; "Report on Electrical Engineering," Prof. D. D. Ewing, Purdue University; "Power Factor and Load Factor—Effect on Central Stations," H. C. Thuerk, Lafayette, Ind.

"The Engineer and the Contractor —Their Relation," C. D. Franks, Indianapolis, Ind.; "Gravel Specifications in Indiana," B. C. Yeoman, Indianapolis, Ind.; "Indiana Highway Problems," by a member of the State Highway Commission; "The Remedy for the County Surveyor's Office," Earl A. Gibbons, Terre Haute, Ind.; "Report on Civil Engineering," W. J. Titus, chief engineer of bridges, Indiana State Highway Commission, Indianapolis, Ind.; "Highway Lessons of the World War," Prof. G. E. Martin, Lafayette, Ind.

American Association of Engineers.

The Twin City Chapter of the American Association of Engineers has been elected a member of the Minnesota Joint Engineering Board, and has appointed for its representative for the first year, Professor Frederic Bass of the University of Minnesota. Professor Bass is a chairman of the National Committee of Engineering Education and a consulting and advisory editor of the "Professional Engineer."

Chapter charters have been granted by the American Association of Engineers at St. Joseph, Missouri; Charleston, West Virginia; Oregon State College, and club certificates at Poplar Bluffs, Missouri, and Peoria, Illinois.

PERSONALS

McClendon & Purnell is the name of a new engineering firm, with offices at Mineral Wells, Tex. The members of the firm are Wm. W. McClendon, a graduate of Texas A. and M., and A. B. Purnell, of Louisiana State University. Mr. McClendon has been city engineer of Mineral Wells for the past five years and has been in direct charge of all paving. Mr. Purnell was a Lieutenant in the 114th Engineers Corps and has had a varied experience in road repair and maintenance in France. The new firm will specialize in municipal and highway work. Mr. McClendon will still act as city engineer and Mr. Purnell will have direct charge of all outside work. The new firm has been supervising asphalt macadam paving and constructing a big storage reservoir in Mineral Wells.

Marshall, U. S., senior highway engineer in the United States Bureau of Public Roads, until recently in charge of the Missoula branch office of the bureau, has resigned to accept the position of assistant chief engineer with the Montana State Highway Commission, at Helena.

Chase, Lieut. Waldo H., U. S. A., recently discharged from service after a year overseas, has resumed his position as engineer with the northern division of the state highway department, California.

Gwillim, E. C., has received the appointment as city engineer of Sheridan, Wyo., to fill the vacancy created by the resignation of H. M. Huntington. Mr. Gwillim was recently discharged from military service.

McFall, James, having finished his work as general fire and guard marshal of the Emergency Fleet Corporation, has accepted a position with the West Penn Power Co., Pittsburgh, Pa. His new address is P. O. Box 1223, Pittsburgh.

Brownell, Capt. O. E., Engineers, U. S. A., who recently received his discharge, has become associated with Morell & Nichols, landscape architects and engineers, Minneapolis, Minn. He will take charge of civil and municipal work. Before entering the army Captain Brownell was chief assistant city engineer of Duluth.

McLain, Capt. G. L., U. S. A., former city engineer of Hutchinson, Kans., has been appointed assistant engineer, Bureau of Public Roads, and has been assigned to the Omaha district, in charge of Kansas work. Captain McLain organized Co. A., 110th Engineers, and has just returned from sixteen months' service in France.

Whipple, George C., Professor of Sanitary Engineering at Harvard University and member of the firm of Hazen, Whipple & Fuller, expects to sail January 24 for Geneva, where he will take charge of the Division of Sanitation of the League of Red Cross Societies, of which he is director. He expects to be absent from his chair at Harvard for one term only, returning to this country in September.

Municipal Journal & Public Works.

City County State

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SIMON BARR, *Assistant Editor*

Contributed Articles and Reports

Contributions suitable for this paper, either in the form of special articles or as letters discussing municipal matters, are invited and paid for.

City officials and civic organizations are particularly requested to send to Municipal Journal and Public Works regularly their annual and special reports.

Information Bureau

The Information Bureau, developed by twenty-one years' research and practical experience in its special field, is at the command of our subscribers at all times and without charge.

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"PUBLIC WORKS."

When, about a year ago, we added to the name "Municipal Journal" the words "and Public Works," it was with the idea of later dropping the first part and adopting the name "Public Works" as a simpler and more comprehensive one. This will be done with the next issue.

Although we drop the name "municipal," we intend to continue to make this the leading paper for city, county and state officials and public works' contractors, and to cover pavements, water-works, sewerage, refuse disposal and the other subjects which we have made our special field during the past twenty years.

Certain other changes which will make the publication of more practical value to its readers will be announced in the first issue under the name of "Public Works."

MAKE ROAD CONTRACTS ATTRACTIVE.

We pointed out last week that there was every indication that a great demand would arise next spring for machinery, materials and contractors for carrying out this year's road construction program. Also how a solution of the materials problem might be furthered.

No less serious, probably, will be the difficulty of obtaining contractors. Thos. H. MacDonald, chief of the Bureau of Public Roads, in a recent letter to the editor of this paper, said: "In practically all of the states there is a real need for experienced and able contractors to engage in highway work. If there is anything that you can do which will induce additional able contractors to engage in this line of work, you will be performing a valuable public service."

Such contractors can be induced to leave other kinds of work for highway work only if the latter is made the more attractive to them. This does not necessarily mean that the profits, as indicated by contract prices, must be greater. In many ways the terms and conditions under which a contractor works may often be made more favorable without imperiling the character of the work or increasing the amount paid for it. For example, prompter payments; more definite specifications, leaving less to the unknown whims of engineers and inspectors; awarding larger sections of work in single contracts; and making such awards before March 1st; each of these would be an improvement over the past practices of many states and counties, which would attract the best contractors to the work without in any way detracting from the character of the resulting highway or adding to its cost.

A contract too often reads like rules under which to conduct a contest. But progressive "parties of the first part" as well as contractors are coming to realize the advantage of making contracts the terms of a temporary partnership, equally fair to both and under which both are co-operating to the same end—the producing of a good job of which both will be proud and from which each will profit.

Engineers as Money Savers

Sometimes it may be economy to save an engineer's salary on public work—but more often it is not; and you never can tell

A friend of the editor, an engineer, on a recent visit to his home town happened to discuss with a city official —a former school-mate—a street improvement contract involving some thirty or forty thousand dollars for which final payment was about to be made to the contractor. Glancing over the quantities and prices, this engineer was convinced by his local knowledge and judgment that the excavation figures were excessive.

He learned that the state had prepared plans for improving the street as a state road, but later withdrew and the village decided to do the work, but, to reduce the cost, modified the plans somewhat without engineering advice and employed no engineer to oversee construction. Bids were received on the state's estimate of quantities and the contractor's engineer gave grades and lines.

At the conclusion of the work the contractor rendered a bill based on the quantities as estimated by the state. The village had no data by which it could check the amounts, and was about to pay the bill as rendered. At the request of the village authorities, the visiting engineer, using the state survey as a basis, checked up grades, fills and cuts. He found that both cuts and fills had been slighted and shoulders not carried out the full width, and the excavation was some 1,600 yards under the estimate—a matter of about $1,800. In addition, charge was made for 900 yards of excavation and 700 yards of backfill in trenches for tile drains; and although the contract was so vague that no one could say just what was intended, the amount bid on the item of furnishing and laying drain tile justified the belief that the contractor contemplated including in it excavation, backfill, paving and a few other things. It seems probable, however, that the bill must be paid as rendered.

The officials of this village are honest and capable men, but do not know much about engineering. The contractor was a pretty good contractor and probably did not himself know how much excavation he did except that it was not more than the estimate. And jobs where there is no engineer in charge are usually regarded by contractors as "soft picking."

Moral: No public works job is too small to need the services of an engineer. On almost any job a good engineer will save many times his pay.

Highway Administration

In a paper with the above title read before the convention of the United States Highway Officials, George H. Biles, assistant state highway commissioner of Pennsylvania, discussed at some length the organization of a state highway department for the spending of the millions that many such departments now have at their disposal.

He said that, in the first analysis, the duties of the several units of the organization should be grouped on a functional basis, the segregation of the special or distinct functions automatically creating the several separate divisions. The divisions may be classified as Executive, Management, Construction, Maintenance, Township, Auto Registration, and Accounting.

The Executive Division consists of the commissioners, with their secretaries, or a single commissioner with assistant and secretary.

The function of this division should contemplate the determination of all policies. It should not be required to enter into the details of the operation of any division of the department. Division heads should be given responsibility and held accountable.

The function of the Management Division may be stated briefly as being to supervise and place in force the principles of management as applied to all branches of the department. It will be found that the most modern and up-to-date principles of industrial management are applicable thereto and, in fact, are necessary for its successful operation.

In this division there should be a Purchasing Bureau, Contract Bureau, Equipment Bureau, Information Bureau, Stenographic, Typing and Duplicating Bureau, and Filing and Mailing Bureau.

The Construction Division is composed of a chief engineer, principal assistant engineer, testing engineer, construction engineers, district enineeers or field men, and a corps of assistants. This division, as its name implies, is concerned entirely with the construction of roads and bridges and the engineering problems incident thereto.

In this division, the grouping of the functions suggest a division into three sections, Engineering, Draughting, and Testing.

The Maintenance Division is in charge of a maintenance engineer with his inspectors, engineers, office assistants and force of superintendents, in charge of the work in the several counties. This is one of the most important divisions of any highway organization for, after considerable sums of money have been expended for road construction, it is vital that the investment be protected through adequate maintenance. On account of the great number of employees engaged upon this phase of the work and the units involved, a high grade system of operation is necessary.

Maintenance work may be classified under the following heads: general repairs, surface treatment, resurfacing, and snow removal, and it is the function of the Maintenance Division to determine and enforce standard methods for handling each class.

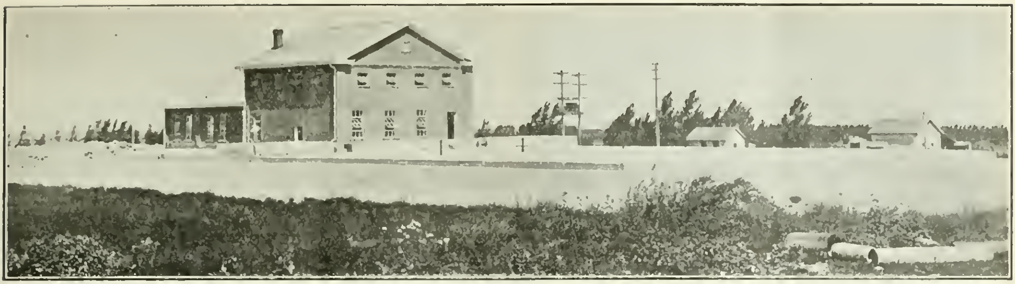
The Township Division is in charge of a township commissioner, with an engineering assistant and office force, together with a field force of township engineers, who act in an advisory capacity to the townships in certain districts.

The Automobile Registration Division is in charge of a registrar with his assistant, cashier and office force, also a corps of field inspectors for the enforcement of legislation regulating the operation of motor vehicles.

The registration of motor vehicles may not ordinarily form a part of a highway organization but, if the statutes so provide, careful consideration must be given to this work.

The Auditing and Accounting Division is in charge of a comptroller, who looks after the department financing and accounting, assisted by a specialized office force and paymasters.

The work of this division is performed by four sections—Payroll Section, Invoice and Expense Account Section, Bookkeeping Section, and Cost Accounting Section.



Rear View of Filter and Head House, Showing Settling Basins

Twin Falls Water Purification Plant

Complete and up-to-date rapid sand filtration plant for an Idaho City of ten thousand population. Sulphate of alumina is fed dry. The valves are operated hydraulically. The effluent is measured by a Venturi meter. The entire operation is regulated by a master controller. The city is being 100 per cent metered as a measure of economy. The plant will be in charge of a trained filter operator.

About ten years ago the site where Twin Falls, Idaho, now stands was nothing more than a barren sage brush waste. Therefore, water for irrigation and domestic needs has played an important part in the up-building of this modern city, which now has about 10,000 population.

In providing water for irrigating the farms, the city also provided, through the same canal, water for its domestic needs and fire protection. The water supply is from the Snake river, from which it is drawn by means of a canal which is located about two and one-half miles south of Twin Falls. From this canal the water for municipal use flows through a 24-inch pipe line, passing through a Venturi meter, and also through a float valve which automatically regulates the elevation of the water in the receiving basins.

The water supply for Twin Falls, as in the case of all other western cities, must be an adequate volume for garden irrigation, lawns, and an unusually large amount for domestic requirements because of the very dry summer seasons. This necessitates procuring three to four times as much water per capita as the average municipality uses throughout the eastern states. The total capacity of the plant is therefore planned for six million gallons per day and the water consumption during certain hours of the day has already reached this large volume.

Many cities through Idaho, Washington, Oregon, Utah, Montana, and other western states procure their water supply from irrigating canals in the same way as does Twin Falls, but the cities using such source of supply have found the canal water so contaminated as to be unsafe to drink without purification. This contamination usually arises because of drainage into the irrigating canals from farm houses and the discharging of raw sewage without treatment into the streams. The conditions in Twin Falls are therefore quite similar to those in many other of the western municipalities and the successful handling of this same problem at Twin Falls may be of interest and helpful to the municipalities of many other western states that must sooner or later solve this same question of providing an absolutely safe water for domestic and commercial needs.

DESCRIPTION OF PLANT.

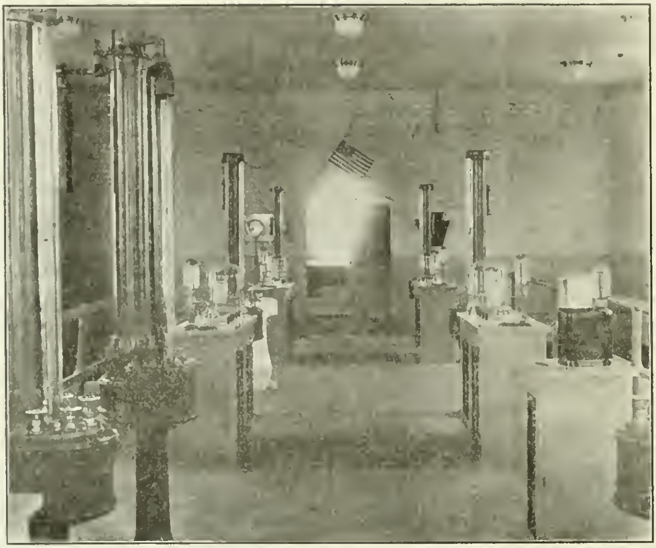
At Twin Falls the canal supply is at sufficient elevation above the city to permit of a gravity plant. The water flows from the canal through a 24-inch pipe line into a receiving basin. The level of the water in the receiving basin is regulated by an automatic float valve which maintains a constant elevation over the filter. The canal at Twin Falls, as is usual with canals, must be emptied at certain seasons of the year for repairs and at times the water in the canal is low, and to provide for such emergencies low-service pumps are utilized for lifting the water from the canal at these low stages into the settling basins. A large settling basin of approximately twenty million gallons capacity has been provided for storage of water during times of repair.

The filtration system is not different from other purification plants that have been described quite fully in engineering periodicals, except that advantage has been taken in this plant of all of the modern improvements and methods utilized in handling of the water. Sulphate of alumina is used as a coagulant and is fed through dry-feed machines in a pulverized condition, passing through a hopper and being delivered to the water as a ribbon of chemicals over a small wheel. In order to insure a thorough mixing of the sulphate, baffle walls are so arranged as to give the water a travel of 1,600 feet, passing up and down through these baffle walls.

FILTER HOUSE AND HEAD HOUSE

bidity, odor and color, and tests made show an average of 98% of all bacteria removed. The design of the purification works, both interior and exterior, is of such a character that they are pleasing to the eye and makes the entire plant one of the show places of the municipality.

The water, after purification, flows to the city by gravity through a line 2½ miles long and 24-inches in diameter. This gravity flow line is of California redwood pipe, the line being built of continuous-stave pipe assembled in the trench. The purification plant is on a hill 190 feet above the city and is delivered to the municipality at a pressure in the mains throughout the business district of 70 pounds per square inch.



OPERATING FLOOR OF FILTER HOUSE

After this thorough mixing, the water passes to two concrete-lined settling basins, where approximately 85% of the sediment and impurities are removed from the water. After the settling basin treatment the water passes over a weir to a concrete flume, flowing on to the sand filters.

Six sand filters are provided, with a normal capacity of one million gallons each, making a total of six million gallons per 24 hours. Each of these filters is provided with a marble top operating table with hydraulically operated valves. The water from each filter passes through a Venturi meter with a recording equipment, so that the rate of each filter can be observed easily. On the operating table each filter also has a control stand so arranged as to indicate the time when the filter requires washing, which will be shown by the loss of head of each filter recorded on the operating table. The washing of the filters is accomplished by means of a wash-water pump of large capacity.

The plant is provided with a master controller, which forces the plant to operate in proportion to the demand of the city, which is one of the latest improvements in purification equipment and is very desirable from the standpoint of economical operation.

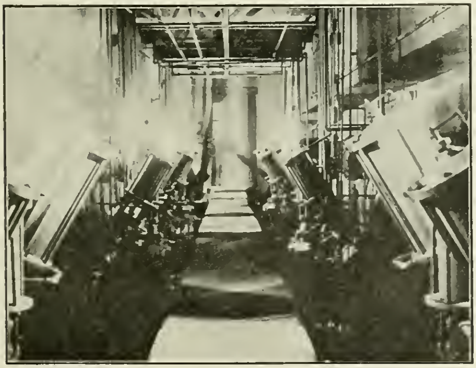
Nothing has been left undone to make the Twin Falls purification plant the most modern plant in the United States. It delivers the water to the city free from tur-

DRY-FEED CHEMICAL MACHINE

For the building of the purification plant and improvements in the distribution system, Twin Falls voted a bond issue of $375,000. While this bond issue may seem high for a city of 10,000, yet it is less than one-half the estimated cost of a gravity supply which had been considered, but for which the voters failed to ratify a bond issue. The entire purification plant, settling basins, and pumping equipment is so arranged that additional units may be added as the growth of the city justifies an increase in capacity.

PREVENT WASTE.

Before the plant was turned over to the city the consulting engineers, Burns & McDonnell, of Kansas City, Mo., through their resident engineer, C. E. Painter, made an investigation of the meter situation, with a view to recommending the complete meterization of the entire city. The result of this investigation showed only 38 meters out of 1,800 taps, and the City Commissioners immediately ordered 500 meters and a price contract was made for future orders and within a short time Twin Falls will be 100% metered. This report of the engineers showed that the present purification plant would have to be extended and enlarged within five years unless prompt action was taken toward curtailing the unnecessary waste of water. Between 11:00 A. M. and 1:00 P. M. and from 5:00 to 7:00 P. M., water in Twin Falls was used at the rate of seven million gallons per day. It will, therefore, be seen that the plant had to run in excess of its normal six million capacity during these peak-load hours; but with restrictions on the waste of water, the present capacity of the plant should be sufficient for 15 to 20 years. An investigation was made of twenty four customers using water on a flat rate. Leaky plumbing was found responsibile for the largest loss on these and meters were installed on these twenty-four users. A later investigation was made to determine the result and it was discovered that while $196 was the revenue produced under the flat rate, under the yearly rate with meters a revenue of $303.88 was produced; and of these twenty-four customers, 50% were being overcharged and the other 50% were being presented water free of charge. This was, of course, not equitable or just. Moreover the total income was increased 55% and much water was saved to the municipality. The City Council and the mayor co-operated with the consulting engineers in carrying out the recommendations, and at Twin Falls, as should be the case in other municipalities, it was felt unwise to operate a modern water purification system and then permit the water to be wasted through illegitimate use.



PIPE GALLERY, SHOWING HYDRAULIC VALVES

The general construction contract was awarded to Heuser-Packard Construction Co., and a local contractor, Mr. Haskins, laid the mains and distribution system. The filtration plant was erected by the Pittsburgh Filter and Engineering Co. The accompanying cuts will illustrate some special features of the plant.

It frequently happens that municipalities will procure a model purification plant and then leave the operation to an inexperienced person, and poor results will often follow. However, at Twin Falls, the city officials procured a trained filter operator in J. E. Byers, who had recently returned from the army service, and under his operation the purification plant receives constant attention, including daily analysis of the water, and the consumers are assured of uniform results with a minimum amount of chemicals and safe water free from dangerous bacteria.

Effect of Vibration, Jigging and Pressure on Fresh Concrete

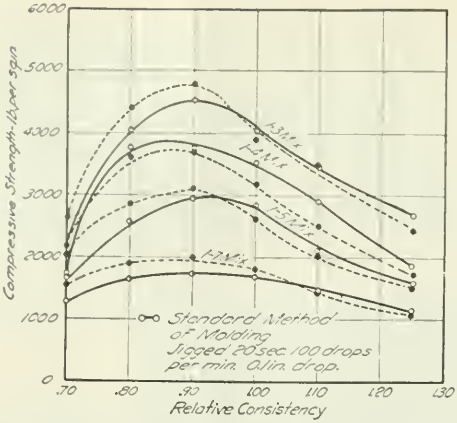
Tests and experiments made at Lewis Institute by Professor Duff A. Abrams led to conclusions, some of which differ considerably from previous beliefs. Vibration and jigging were of no benefit where the concrete had been thoroughly hand-puddled. Pressure on puddled concrete increased its strength by expelling the superfluous water.

The Structural Materials Research Laboratory of Lewis Institute, Duff A. Abrams professor in charge, has made an experimental study of the effect which vibration and pressure applied to fresh concrete has on its strength and other properties, and the results and conclusions are given in a report by Prof. Abrams. A brief description of the tests, and the summary and conclusions, are given below.

This study "is of interest in view of the frequent use of such devices as hand-hammering of forms, or air-hammering, jigging or vibration as an aid in placing concrete. Such methods are particularly applicable to the construction of reinforced concrete ships and houses (also pipes, etc.), where thin sections and a multiplicity of reinforcing members are of common occurrence. Jigging or vibrating machines are frequently used in concrete products plants. The effect of pressure on fresh concrete is of interest in certain problems of concrete design."

NATURE OF TESTS.

The tests included different methods of hand-molding of test cylinders, the effect of vibrating fresh concrete, effect of jigging fresh concrete, and effect of pressure on fresh concrete. In testing the effect of jigging, concretes were tested having different mixes, different consistencies, and aggregates of different grading, sizes and shapes; different rates of jigging were employed, different heights of drop and lengths of time, different ages of concrete were tested, and hand-puddling of



EFFECT OF CONSISTENCY ON STRENGTH OF JIGGED CONCRETE
Specimens moulded by standard method and parallel sets jigged. Compression tests of 6x12-in. cylinders. Age 28 days. Full line, unjigged; dotted line jigged.

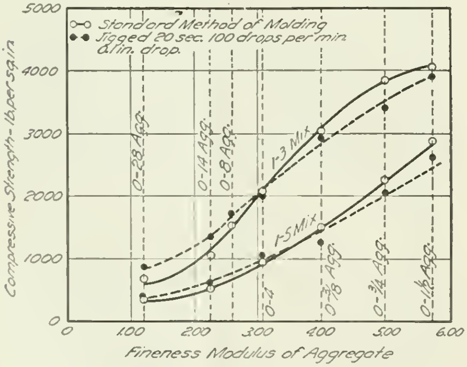
concrete while being jigged was also tested. Nine hundred tests were made in the series. In only one group of tests was broken stone used as a coarse aggregate, pebbles being used in all the others.

In practically all cases the specimens were molded by the standard hand-puddling method before subjecting them to either vibration, jigging or pressure. That is, the concrete had previously been thoroughly compacted and therefore the test gave little or no information concerning the effect of either of these treatments in increasing the density of the concrete.

In the vibration test, the concrete was placed in a cylindrical mold which was bolted to a light timber table, and vibration was produced by holding against the side of the steel form an electric motor which carried an eccentric fly-wheel that weighed 12 pounds and made about 1,000 revolutions per minute.

Jigging tests were made on a machine consisting of a metal table about four feet by eight feet which was caused to rise and drop by cams on two revolving longitudinal shafts.

In applying pressure, light pressures were obtained by applying weights, but pressures from 100 to 500 pounds per square inch were obtained by placing the freshly molded specimen in a testing machine.



EFFECT OF SIZE OF AGGREGATE ON STRENGTH OF JIGGED CONCRETE
Compression tests of 6x12-in. cylinders. Age 28 days. Full line, unjigged; dotted line, jigged.

The report gives tabulated data obtained by the several tests, from which the author concluded that "hand-puddling (if thoroughly done) is just as effective as vibration in placing concrete. In other words, concrete which completely fills the form is not improved by vibration. This should not be construed as meaning that vibration is not effective in causing concrete to find its way into intricate form work and around reinforcing bars." "In general, jigging of concrete which has been placed by puddling is injurious to the strength."

"The tests of concrete setting under pressure are of interest in that they reveal the reason for increased strength due to this treatment. The concrete strength is increased due to the fact that some of the original mixing water is forced out. The higher the pressure, the more water is removed, hence the higher the strength."

SUMMARY AND CONCLUSIONS.

The author's "Summary and Conclusions" are given in full and were as follows:

EFFECT OF PUDDLING AND TAMPING.

1. Varying the number of strokes from 12 to 50 on each 4-inch layer in the standard method of hand-puddling with a ⅝-inch bar had little influence on the compressive strength of ordinary plastic concrete.
2. In general, the tamping methods used gave lower strengths than hand-puddling.
3. A tamper of large diameter for a given weight was less effective than one of small diameter.
4. Increasing the thickness of the layer from 4 to 6 inches caused a falling-off in strength of about 12 per cent for tamped concrete.
5. Tamping or puddling the first 4-inch layer only, caused a falling-off in strength of 10 to 13 per cent.
6. Striking the metal form with a steel bar after the completion of molding by standard method had no effect on the strength of concrete.
7. The "standard" method of hand-puddling using 25 strokes with a ⅝-inch steel bar for each 4-inch layer of concrete in a 6 x 12-inch cylinder is recommended for laboratory tests of concrete. .

EFFECT OF VIBRATION WITH ELECTRIC HAMMER.

8. Vibration of the specimen after molding by means of an electric hammer running at 1,000 r.p.m. had little influence on the strength of the puddled concrete up to a period of about 30 seconds. If continued, there was a steady falling-off in strength; after 45 to 60 seconds the strength was only 90 per cent of that produced by the standard method of puddling.

EFFECT OF JIGGING.

9. In general, jigging in any manner with the apparatus used reduced the compressive strength of the concrete regardless of the height of drop, rate or duration of treatment. Exceptions were found in the dry mixes and those made of aggregates of the smaller sizes.
10. There was little difference in the effect of jigging due to the quantity of cement used.
11. In the very dry mixes the strength, due to jigging for 20 seconds, was increased about 25 per cent.
12. The wetter mixes (relative consistency 1.10 to 1.25) were reduced in strength 3 to 6 per cent by jigging.
13. Pebbles and crushed limestone as coarse aggregate gave essentially the same results in the jigging tests.
14. The concretes from the finer aggregates showed a material increase in strength with jigging in both 1:5 and 1:3 mixes.
15. For aggregate coarser than about ⅜ inch, jigging reduced the strength from 3 to 10 per cent.
16. The grading of the aggregates (for a given maximum size) had little influence on the effect of jigging.
17. The greater the drop the greater the reduction in strength for 1:5 concrete. For a drop of ½ inch the strength was reduced 12 per cent.
18. The faster the rate of jigging the lower the strength

of 1:5 concrete. Using 1½-inches aggregate at 150 r.p.m. the strength was reduced about 13 per cent.

19. The strength of 1:5 concrete fell off rapidly with the duration of jigging. After 2 to 3 minutes jigging the strength was reduced about 20 per cent. as compared with standard method of hand-puddling.

20. Allowing the concrete to stand for a period of time before jigging, increased the strength to a slight extent. The maximum increase was found at 2 to 4 hours.

21. The application of a pressure of 1 pound per square inch during the jigging process (equivalent to a head of 1 foot of fresh concrete) gave the same strength as standard hand-puddling.

22. Molding the cylinders by the standard method on the jigging table while it was in motion, gave the same strength as standard hand-puddling without jigging.

EFFECT OF PRESSURE.

23. The compressive strength of concrete was increased by pressure applied immediately after molding. For pressure of 200 to 500 pounds per square inch the increase was 20 to 35 per cent.

24. The duration of pressure as between 15 minutes and 16 hours produced no difference in strength.

25. There was a steady reduction in the water-ratio of the concrete with the application of pressure.

26. The application of pressure increased the strength of concrete in accordance with the quantity of mixing water expelled.

27. The tests of concrete subjected to pressure showed the usual relation between compressive strength and water-ratio. The strength is increased **because the water is expelled.** In other words, pressure produces a drier concrete, and consequently gives higher strength. This makes it clear why the duration of pressure has no influence on the result.

FURTHER DISCUSSION OF VIBRATION, JIGGING AND PRESSURE TESTS.

The indications of the vibrations and jigging tests should not be misinterpreted. The tests show that **after the concrete is properly placed** these methods of treatment do no good and may be harmful if too severe or too long continued. However, there can be no doubt of the value of such methods **for getting concrete into place** in intricate forms and around reinforcing bars. The tests are of value in showing that this is the only desirable function of such treatments. The tests show the ill effects of lack of compactness in the concrete. Here the strength was reduced 13 per cent due to failure to tamp or puddle the top 9 inches of the cylinder. It is impracticable to duplicate in a compression test piece the performance of air hammers and other similar methods of vibrating when used on reinforced concrete work.

The tests show that with jigging high strength may be secured with drier mixes than would be feasible otherwise. It is a matter of common experience that concrete of drier consistency (and consequently higher strength) can be placed by means of jigging or vibration than would be possible by the usual methods.

The roller method of finishing concrete roads, walks and floors is an interesting example of a combination of slight vibration and pressure accompanied by the removal of excess water. Transverse tests on concrete made in this laboratory showed a marked increase in strength of the rolled slabs as compared with similar slabs without rolling.

It is clear from these tests that if tamping, vibration or pressure on fresh concrete are to be effective in increasing its strength three factors must be kept in mind:

(1) We must take advantage of the fact that with these methods the concrete can be placed and finished dryer than with ordinary methods.

(2) Excess water which is brought to the surface must be removed.

(3) We must take advantage of the fact that aggregate of a coarser grading may be used when such methods are employed than would be practicable otherwise.

The advantages to be gained under (3) are due to the fact that up to a certain point a plastic mix can be secured with a smaller quantity of water if the aggregate is as corase as practicable. Unless these precautions are taken, tamping and vibration are of doubtful value.

Connecticut Highway Work

Sixty per cent of the expenditure was met by automobile fees. Three-fourths of it was used for maintenance and only one-fourth for new construction. Gaps in state system filled in. Use of machinery greatly increased. Road widths increased. Handling federal equipment.

The Connecticut Legislature in 1919 established June 30th as the end of the fiscal year for the State Highway Department, instead of September 30th as before, and the report of that department for the nine months ending last June has just come to hand.

This report shows that during these nine months the department spent $435,751 on new state roads; $423,549 on maintenance and construction of bridges, and $1,437,191 for maintenance and reconstruction of roads. The total gross expenditure of the department, including $89,442 overhead, was $2,385,934. A large part of this was met by automobile fees which, during the nine-month period, totalled $1,361,898. It will be noticed that more than three times as much was spent on maintenance and reconstruction as on new roads.

Early in 1919 the department was urged by Governmental agencies and others to prepare an abundance of highway construction to provide work for the returning soldiers. The department endeavored to comply but found that these men were not anxious for work of this character, there being other and more lucrative kinds which they could secure easily. In fact, there was a shortage of labor which at times approached the acute.

A total of 27.81 miles of new road were built, making the total mileage of both state aid and trunk line state highways 1,510.83 miles.

The work of filling in incompleted gaps in the state system was very firmly established by the Legislature of 1919, which made a special appropriation for this purpose, requiring the highway commissioner to expend a total of $600,000 on the completion of unfinished gaps in the state aid highway system. As a result of this most beneficial legislation, the department has been able to complete these unfinished gaps on seven of the main lines, which will "do much to round out the highway system of the state and make it possible for motorists to proceed without undue inconvenience over continuous stretches of state highway."

The expenditures for repairing trunk line roads alone for the past five years increased continuously from $785,099 in 1913-14 to $1,641,693 in 1917-18. The expenditure for the nine months of 1918-19 was $1,064,223, which undoubtedly was increased before the end of the year, since the expenditures for road repairs, maintenance and reconstruction are heavier during July, August and September than during any other six-month period of the year.

The increasing use of machinery in highway work is indicated by the fact that the Connecticut department spent for motor trucks, crushers, rollers, scrapers and other maintenance equipment, during the five latest fiscal years, the following sums respectively: $24,106, $55,271, $65,308, $193,101, $111,996 (nine months only). It is the policy of the department to "charge this equipment against the jobs on which it is used at a price equal to the ordinary rental of similar equipment from outside sources. Refunds are paid back to the repair department on this basis and included in the expenditures for ordinary repairs." The equipment service therefore is practically self-supporting. "There can be no criticism of the rentals charged, as they are the same or a trifle less than the prices charged by owners of equipment outside" the department.

In a previous report mention had been made of the establishment of a repair plant at Portland, Conn., for the purpose of taking care of the highway department equipment. At the time this plant was constructed no intimation had been received that the Federal Government would allot the several state departments the large number of motor trucks and other machinery which has since been distributed. The fact that the department had this repair plant to use as a point of concentration of this Federal equipment was a remarkable advantage to the department in receiving, classifying and repairing the equipment.

Storage tanks for bituminous materials have been established at various points within the state and have aided greatly in facilitating promptness in repairing roads.

The department feels the need of increasing the widths of the roads, some of which at present carry a maximum traffic of 9,000 vehicles a day and an average traffic of more than 4,000. "The accommodation of such volume of traffic evidently requires the careful consideration of highway widths, surfaces and alignment. In no case should roads be built less than 18 feet in width on the main traveled roads. In some instances, widths are made up to 22 feet with corresponding extra widths on curves."

Hog Feeding at Baltimore

Since May, 1919, the garbage collected by the city of Baltimore has been fed to hogs on a farm situated on Bodkin creek which is owned by the city and leased to the American Feeding Company, which has a contract with the city for the garbage, as described in the issue of Municipal Journal and Public Works for March 22, 1919.

Under this contract the city collects the garbage and delivers it by water to the farm, while the company pays to the city for each ton of garbage three and a half times the average top price per pound of live hogs for the month in question on the Chicago market. During the four months August to November the city received from the contractor about $7,000, while the cost of towing the garbage during that period was about $2,500, leaving a cash balance in the city's favor of about $4,500. This does not represent the entire profit of the arrangement, however, for in previous years the city paid about $75,000 a year to a contractor for disposing of the garbage.

At present the garbage supplied by the city is scarcely sufficient to feed 3,000 hogs, while the capacity of the farm is 6,000 to 7,000 hogs. As a matter of fact, the city collectors are not getting all the garbage and the authorities are endeavoring to make the collections more thorough. It is stated that if the amount delivered in the future should not be sufficient to justify the American Feeding Company in maintaining the farm, the arrangement with the city may be terminated when the present contract expires.

The contractor is always glad to receive at the farm visitors who are really interested in raising hogs or disposing of garbage by this method. The farm can be reached by boat, or by automobile via the Annapolis road and the road to Lake Shore.

Reducing Typhoid Fever Rates

The typhoid death rate in the registration area has been reduced from 20.5 to 8.1 in ten years. Every state shows a decrease, but the north Atlantic states the most. A table is given showing the yearly rates for the registration states and large cities during 1906 to 1917.

From the point of view of those engaged in the construction and operation of public works, typhoid fever is the most important disease because it is the one that they can do most toward eliminating.

As a destroyer of human lives, however, it is far down in the list. For instance, in the registration area of the United States, the typhoid fever rate per 100,000 in 1917 was only 8.1; while of the twelve principal causes of death, only one, scarlet fever, had a lower rate than this, and heart disease was accountable for a rate of 198.4, pneumonia for 164.8, tuberculosis for 146.7 and the other diseases for lower rates.

It certainly is greatly to the credit of engineers and others interested in fighting typhoid fever, however, that it is one of the five diseases whose rates have decreased during the past ten years, and its rate of decrease has been greater than that of any of the others. Tuberculosis shows a decrease from 176 to 147, but the rate of decrease was less than that of typhoid fever, from 20.5 to 8.1, in spite of the nation-wide campaign against the former disease. There was a slight increase in the typhoid rate in 1916 and 1917 over that for 1915, a part of which at least can be attributed to the inability of some cities to obtain a sufficient amount of liquid chlorine for treating their water supplies on account of the demand for this for war purposes.

CENSUS FIGURES FOR 1906 TO 1917.

The latest mortality statistics issued by the Census Bureau are those for the years 1917, which have appeared within the last few weeks, and these give the figures for the so-called registration area for each year from 1906 to 1917 inclusive. From this we have compiled the accompanying table, omitting, however, all states and cities which were not included in the registration area in 1906, in order that the changes in the rates may not be obscured by the addition year by year of new areas. This table is in two parts, one giving the typhoid rates by states and the other by cities. Only the larger cities of 100,000 population or more are included.

Study of these figures is very interesting and encouraging. It shows, for instance, that there has been a decrease in the rates in each state, which has been continuous except for an increased rate in each state during one year (in two or three states, however, there were

Registration States	**1906 to 1910**	**1911**	**1912**	**1913**	**1914**	**1915**	**1916**	**1917**
California	23.8	17.3	17.2	15.9	13.4	9.7	7.1	7.2
Colorado	43.3	30.3	15.4	17.0	17.0	12.7	12.2	9.4
Connecticut	17.5	13.5	10.9	11.3	9.2	12.4	7.5	9.3
Indiana	34.7	26.7	23.5	25.1	21.2	14.9	21.5	17.5
Maine	18.2	18.0	13.7	12.0	16.0	13.4	11.1	10.5
Maryland (total)	39.1	37.5	27.8	33.3	23.9	23.7	19.4	18.6
White	35.4	33.6	24.5	26.7	21.5	18.5	16.4	16.2
Colored	55.6	55.5	43.0	63.6	34.9	48.9	34.2	30.8
Massachusetts	13.7	9.0	7.7	7.9	7.6	6.7	4.7	4.8
Michigan	24.4	19.1	18.6	18.4	13.3	11.7	14.1	12.6
New Hampshire	15.3	14.6	8.7	11.9	8.7	7.7	5.0	6.1
New Jersey	14.9	12.0	11.5	9.6	8.2	6.7	7.0	6.7
New York	17.0	14.1	11.6	10.3	8.9	7.6	5.9	5.6
Pennsylvania	36.4	21.9	16.4	18.1	13.0	12.3	13.6	10.4
Rhode Island	13.1	9.5	7.7	8.3	8.1	10.1	6.8	5.4
Vermont	15.7	12.3	11.2	7.8	11.6	13.0	6.3	6.9
Average	23.4	18.3	14.4	14.8	12.9	11.6	10.2	9.4

Registration cities of 100,000 population or more in 1910.	**1906 to 1910**	**1911**	**1912**	**1913**	**1914**	**1915**	**1916**	**1917**
Los Angeles, Cal.	18.7	11.6	15.0	12.1	7.7	5.7	2.6	5.8
Oakland, Cal.	24.0	14.0	13.7	12.0	6.6	6.8	4.0	2.4
San Francisco, Cal.	27.0	15.3	13.6	16.1	12.7	9.0	3.5	4.7
Denver, Colo.	40.0	18.0	15.2	13.5	9.0	6.3	7.3	5.2
Bridgeport, Conn.	10.8	3.8	8.3	6.2	3.5	5.1	9.0	8.0
New Haven, Conn.	30.4	24.9	24.4	12.7	15.2	19.7	8.7	10.5
Washington, D. C. (total)	36.4	22.2	23.0	16.4	11.9	12.0	12.9	13.5
White	31.2	19.5	20.0	14.1	6.3	8.5	9.5	5.6
Colored	49.2	28.9	30.5	22.0	25.7	21.2	22.0	34.8
Atlanta, Ga. (total)	62.1	66.1	41.9	21.9	46.3	15.7	22.0	20.9
White	60.5	58.2	34.2	18.2	46.2	17.3	20.5	18.4
Colored	65.1	81.8	57.1	29.2	46.5	12.1	25.4	26.6
Chicago, Ill.	15.7	10.9	7.4	10.4	6.6	5.3	5.2	1.9
Indianapolis, Ind.	29.8	25.8	17.8	24.4	25.8	14.3	26.1	10.9
Louisville, Ky. (total)	52.9	23.7	21.8	23.2	25.9	13.9	13.4	15.8
White	44.4	17.7	16.5	19.4	23.9	12.3	11.2	14.1
Colored	90.8	51.0	35.8	40.3	35.2	21.5	23.9	23.8
New Orleans, La. (total)	35.1	31.0	14.0	16.9	21.9	20.5	23.1	23.3
White	32.5	23.2	11.6	14.5	18.8	19.6	20.4	20.1
Colored	42.3	52.6	20.5	23.4	30.4	23.0	31.0	32.6
Baltimore, Md. (total)	35.4	27.6	24.6	23.8	22.6	20.7	18.1	15.6
White	33.6	25.9	23.6	19.1	22.2	16.9	18.0	14.4
Colored	45.2	37.2	30.0	50.3	24.9	42.1	19.2	22.5
Boston, Mass.	16.2	8.7	8.0	8.2	9.0	5.2	3.4	3.0
Cambridge, Mass.	9.8	2.8	3.7	9.2	1.8	1.8	1.8	4.4
Fall River, Mass.	14.7	14.7	18.0	8.9	9.6	15.0	10.9	16.9
Lowell, Mass.	14.9	7.3	10.1	10.0	10.8	16.1	11.5	6.1
Worcester, Mass.	11.9	6.0	3.3	5.8	3.8	5.6	3.7	6.0
Detroit, Mich.	21.9	15.8	17.5	29.4	14.1	13.5	14.7	17.8
Grand Rapids, Mich.	29.0	26.7	33.9	18.2	27.6	27.8	16.4	12.8
Minneapolis, Minn.	31.9	11.9	11.7	12.0	12.5	7.6	5.5	6.4
St. Paul, Minn.	18.0	10.5	10.6	9.1	11.0	7.0	5.7	2.4
Kansas City, Mo.	36.4	29.9	12.0	21.9	16.3	9.7	11.4	12.1
St. Louis, Mo.	16.3	16.1	10.7	16.9	12.0	6.8	9.4	8.2
Omaha, Neb.	41.1	18.1	14.0	7.6	4.5	6.1	3.0	4.5
Jersey City, N. J.	12.6	7.2	7.8	10.8	7.5	5.7	7.2	3.5
Newark, N. J.	15.1	10.5	8.1	8.7	7.5	2.8	6.1	4.1
Paterson, N. J.	8.3	7.0	5.4	8.3	4.5	4.4	4.3	12.1
Albany, N. Y.	17.3	18.8	17.7	27.4	17.5	12.6	7.5	12.2
Buffalo, N. Y.	23.1	25.0	11.8	15.4	16.3	10.0	10.9	10.1
New York, N. Y.	13.5	10.9	9.6	7.0	6.3	6.0	3.9	3.9
Rochester, N. Y.	13.3	10.6	11.7	8.9	10.2	6.0	5.0	3.0
Syracuse, N. Y.	16.0	16.2	16.7	13.0	10.0	5.9	12.2	6.3
Cincinnati, O.	30.9	11.4	7.7	6.8	6.2	7.4	3.2	3.9
Cleveland, O.	15.9	14.2	6.9	14.1	8.1	7.9	5.3	7.7
Columbus, O.	41.6	13.9	19.6	19.1	13.2	13.4	13.0	7.7
Dayton, O.	25.4	18.6	19.1	18.0	11.3	17.5	19.7	14.7
Toledo, O.	41.0	23.1	31.7	41.6	36.9	22.9	22.2	8.9
Portland, Ore.	23.5	19.1	16.6	6.5	6.9	5.1	4.7	5.5
Philadelphia, Pa.	41.4	14.6	12.8	15.7	7.6	6.8	7.6	6.3
Pittsburgh, Pa.	66.8	25.6	13.1	19.5	15.0	10.3	9.0	11.9
Scranton, Pa.	33.5	14.3	10.3	9.4	9.2	12.5	6.1	6.0
Providence, R. I.	14.6	12.1	10.2	11.2	11.0	8.0	5.1	6.2
Memphis, Tenn. (total)	41.6	65.4	58.9	34.2	42.6	26.7	....	25.0
White	35.1	53.9	41.3	33.3	36.1	23.8	....	23.6
Colored	50.8	82.6	85.4	35.6	52.3	31.6	....	27.6
Nashville, Tenn. (total)	61.8	53.9	32.8	36.9	51.3	37.1	....	22.9
White	55.8	51.0	22.5	39.4	44.2	25.0	....	21.9
Colored	73.7	59.7	53.6	31.8	65.7	63.7	....	25.0
Richmond, Va. (total)	35.4	17.8	16.7	20.3	14.1	12.3	23.6	6.9
White	38.3	19.5	19.2	21.3	9.4	6.1	16.9	3.9
Colored	30.3	14.8	12.5	18.4	22.3	23.4	35.7	12.4
Seattle, Wash.	24.8	10.3	7.6	4.7	7.0	2.4	3.2	4.9
Spokane, Wash.	50.0	35.6	17.4	7.0	12.5	9.8	2.0	7.6
Milwaukee, Wis.	27.8	19.0	25.7	11.3	8.1	5.1	15.3	6.1
Averages	28.1	19.2	16.1	15.2	14.1	10.9	9.2	9.1

two small one year increases, and even these increases were not so large as to indicate what might be called an epidemic. Averaging all of these states, we find a continuous decrease, except for the year 1913, totaling 50 per cent in six years.

These figures also show that the lowest rates are to be found in the North Atlantic states, these taking the following order: Rhode Island leading, then Massachusetts, New Jersey, New Hampshire, New York, Connecticut and Maine. South of New Jersey the rates increase rapidly, Pennsylvania's rate being double that of Maine's.

Many interesting features are noticed in comparing the figures for the cities of more than 100,000 population. One of these is the considerable difference in the rates to be found in adjacent cities. For instance, Boston and Cambridge, Mass., are separated only by the Charles river and many residents of the latter have their places of business in the former, and yet the Cambridge rate averaged less than half of the Boston rate up to 1917, when there was a mild epidemic in Cambridge. St. Paul and Minneapolis have had rates very similar since 1910, but the average for the five years previous to that showed greatly to the advantage of St. Paul.

Another interesting point illustrated by these figures is the higher rate among the colored than among the white population, and the lower rate of decrease among the former. For instance, in Washington, D. C., the averages for 1906 to 1910 and for 1917 respectively were, for whites, 31.2 and 5.6, and for colored, 49.2 and 34.8; a reduction of about 82 per cent in the white rate and less than 30 per cent in the colored. Also in Atlanta, the white rate has fallen from 60.5 to 18.4 and the colored rate from 65.1 to 26.6. In New Orleans the colored rate in 1917 was practically the same as the white rate was ten years earlier.

DECREASED RATES IN ALL CITIES.

Perhaps the most encouraging feature of all which show prominently in this table is the fact that in only seven cities has there been a year during the last five years of the table in which the rate equalled the average for the five years 1906 to 1910; while in every case the average for the last five years was much smaller than for the five years 1906 to 1910. The increases in the seven cities just referred to as exceptions were comparatively slight, being 15.0 as compared to 14.7 in Fall River, 16.1 as compared to 14.9 in Lowell, 29.4 as compared to 21.9 in Detroit, 16.9 as compared to 16.3 in St. Louis, 27.4 as compared to 17.3 in Albany, 41.6 as compared to 41.0 in Toledo, and 42.6 as compared to 41.6 in Memphis.

Averaging all the cities in the table, we find a continuous decrease in rate from an average of 28.1 for the years 1906 to 1910, to only 9.1 for the year 1917.

That further progress can be and should be made is indicated by the fact that, although the average for the 49 cities in 1917 was 9.1, there were 32 cities below that average and many of these very much below; Chicago leading with a rate of 1.9, and 13 having a rate below 5.0. Therefore, while there has been a saving of lives indicated by a reduction in rate of 19 per hundred thousand, a further reduction of at least five per hundred thousand would seem to be possible and therefore necessary.

MORE THAN TEN THOUSAND DEATHS PREVENTED THIS YEAR.

What this saving in lives means is indicated by the following figures, obtained by applying to the total population of the tabulated cities for each year, the difference between the mean rate for that year and the mean rate for the five years 1906 to 1910. Such a calculation shows a saving of lives for each of the seven years from 1911 to 1917 as follows:

1911........	1,896	deaths from typhoid prevented
1912........	2,570	" " " "
1913........	2,830	" " " "
1914........	3,105	" " " "
1915........	3,850	" " " "
1916........	4,337	" " " "
1917........	4,467	" " " "

It seems probable that for 1919 the saving has at least totaled five thousand. This is for the cities named in the table only, with a combined population in 1917 of 23,509,652. This was about 21 per cent of the population of the country. If the reduction in typhoid death rates for the remainder of the country was only half as great, we have a total saving for the country of about 12,700 in 1917. And if the rate could be reduced to 4 per 100,000 the country over, at least 25,000 less deaths per year would occur from typhoid than if the average rate for 1906-1910 had continued.

Preparing Water Pipes for Paving

When streets are to be paved in Chicago, the water works department inspects all its mains and services in such streets and corrects all defects found. During the year 1918, because of the war, less of this was done than usual, but 69.71 miles of streets were covered, a leakage of 1,272,264 gallons per day was measured and 92 per cent of it located and stopped.

During the three years that this service had been performed, 254 miles of pipe had been tested and an average leakage found of 15,819 gallons per mile. If this rate applied to the entire system, 6.75 per cent of the 1918 pumpage was lost through such leaks.

An important discovery made by the Plumbing Inspection section was that there were 110 connections between the city's water pipes and supplies from other sources such as river, wells or cisterns. These were all cut off.

This section, in inspecting service pipes in streets to be paved, furnished the inspector with plats of the streets, showing recorded service pipes. He was required to check these records, make recommendations for cutting off unnecessary pipes, notify owners to increase the size of pipes which were too small and recommend any work required to put the service pipes in good shape. The reports were turned over to the division engineer and used in preparing orders for work to be done on these streets.

Reconstructing Ft. Madison Pumping Station

In the reconstruction of the water works plant at Fort Madison, Iowa, a temporary smoke stack, made of old corrugated iron culvert pipe, was erected and supported above the boiler by structural steel frame taken from the old building and was also supported by guy wires placed so as not to interfere with the later work of placing the roof trusses and other building operations. Later a complete new stack was erected, and as soon as the new boilers were placed the new breeching was put in place and connected to the new stack. Meantime, the new building was being constructed, the firemen and engineers being protected from the winter weather by canvas covers stretched over framework above the boilers and pumps.

The WEEK'S NEWS

State Highway Financing in Pennsylvania, Texas, Michigan and New Jersey—Venereal Disease Legislation Upheld in Kansas—Low Death Rate Record in New York City—To Develop Hydroelectric Power of Great Lakes—Socializing Electric Power in Germany—San Francisco Wins Gas Rate Case—Regulation of Motor Trucks in Massachusetts—Omaha Planning Zoning Ordinance.

ROADS AND PAVEMENTS

Bonds for Durable Roads Only.

Harrisburg, Pa.—The state highway department, given authority under the Act of 1919 to control the expenditure of county money in so far as it applies to the construction of roads, will not countenance the expenditure of borrowed money on any improvement other than of a durable type. Long-time bonds, the state highway department says, cannot be used to build short-time roads. The department's announcement came as a result of the visit of commissioners of Venango county who advised highway commisioner Sadler that the people of that county have it in mind to use a million dollar bond issue for the construction of cinder roads. Such a procedure, the visiting commisioners were told by commissioner Sadler, would be economically unsound. This ruling applies not only to Venango county, but to every other county in the state.

County Highway Funds in Depositories.

Austin, Tex.—The proceeds from the sale of road bonds must be placed in the county depository, according to an opinion given by the Attorney General's Department. The question was put up to the Attorney General's Department if it would be legal for a bank other than a county depository to sell bonds of a road district, issue certificates of deposit payable in monthly installments and pay interest thereon, and also give bond to the district, guaranteeing performance of such contract. A negative answer is given the opinion saying that "the Legislature has not yet seen fit to authorize road districts to select their own depositories, and until such a law is passed by the Legislature road districts must deposit their funds in the county depository."

800 Miles Added to Michigan Roads.

Lansing, Mich.—Since the beginning of the fiscal year on July 1, 1919, when the state's big road building program got under way, 797.32 miles of improved state reward roads of all kinds have been completed under supervision of the state highway department. Of this mileage approximately 40 per cent represents state trunk line highways, built under the plan which will eventually expend the $50,000,000 provided for in the constitutional amendment adopted by the voters last April. Contracts for the construction of 869.82 miles of the above classes of roads have been awarded since last July 1. The road contracts amount to $10,248,675, of which the state will pay approximately $4,900,000, the remainder to be paid by assessment districts, counties and by the federal government. The state trunk line contracts to date total $3,981,409, of which the state will pay about $3,300,000 under the new trunk line highway laws passed at the special session of the legislature last June. Most of these contracts were completed before the close of the season, the total mileage contracted being 330.06 miles. The state has already issued and sold $2,000,000 worth of bonds to finance this work and $2,000,000 more has been obtained by issuance of the state's notes as provided in the new law; these notes will be redeemed next spring by money from another issue of bonds. It is planned to expend about $5,000,000 each year until the trunk line road program is completed under the provisions of the new constitutional amendment and laws supplementing it. Under the new trunk line highway law counties pay from 5 to 25 per cent of the cost of construction, the state paying from 75 to 95 per cent, depending on the ratio between the equalized valuation of the county to the miles of trunk line road allowed. The higher the equalized valuation is in this ratio the more the county pays. Assessment district contracts awarded during the present fiscal year represents 324.52 miles of road at a cost of $3,317,710, the state's share of the cost being 25 per cent, or $829,427. The balance of the cost is paid by the lands included in the assessment districts. Federal aid contracts amount to $2,949,555, representing 215.23 miles of road. The state pays 25 per cent of this, or $737,388, the federal government 50 per cent and the locality affected the balance. In addition to the foregoing road construction in the state, there will also be under construction or contracted for at the close of the year aproximately 700 miles. Comparative costs per mile, 16 feet width, of different classes of roads for 1919 are: B-gravel, $11,662; C-stone-gravel, $12,438; E-waterbound macadam, $14,093; F-concrete, $24,607. The same comparative costs for 1918 were: B-gravel, $10,112; C-stone gravel, $11,223; F-concrete, $20,762. The percentage of increases for 1919 over 1918 are respectively 14.3, 10 and 18.6. The total number of highway contracts now outstanding is 170, and for bridges is 70. During the past road building season several important connections have been made in some of the main highways of the state.

Highway Activity in Western North Carolina.

Asheville, N. C.—More than 264 miles of public roads are under survey, 47 miles are now being constructed and during the past year 10½ miles have been completed by the state highway commission for the western district, comprising 22 counties in the western section of the state, according to figures given out by Wythe M. Peyton, division engineer, whose main office is here. This amount of work going on is considered very satisfactory since only in July was it first made possible to have any state funds available, for on that date the state automobile tax law went into effect. It is estimated that near $2,000,000 is now available for highway improvement in this district, these figures including the automobile tax, federal aid, state aid and funds appropriated by counties to match state and federal aid. The links of roads being constructed, for which contracts have been let and those under survey, all form connecting links on the main highways, including the Central, Asheville-Charlotte, Asheville-Spartanburg, Asheville-Brevard, Asheville-Murphy-Atlanta, Dixie, Asheville-Burnsville, Spruce Pine, East Tennessee and Southwest Virginia, Boone Trail and Blowing Rock highways.

Highway Progress in New Jersey.

Trenton, N. J.—Policies of the New Jersey State Highway Commision, what it has accomplished since its formation and its plans for the future, are outlined in a report hy John W. Herbert, chairman of the commission. The highway program for 655 miles will require an outlay of $35,000,000. After telling of the formation of the commission and the halting of the highway construction during the war, Mr. Herbert describes the work already undertaken by the commission. The report continues: "As to progress, it should be borne in mind that, although the state highway commision was created and the highway system established by the legislature of 1917, no funds were available from the first year's tax levy until March, 1918.

Therefore the commission could do nothing but make survey and prepare plans during the first year of its life. Attention has been called to the fact that immediately following its creation in 1918, the federal government, due to war requirements, prohibited the commission from performing any work on state highway construction, except on Route 1, in Metuchen, and on Route 4, between Matawan and Red Bank, both of which were hampered and delayed by the numerous governmental restrictions. As a result, the commission, in the first year (1918) which it was enabled to perform actual construction, was allowed to build and open to traffic but approximately seven miles of the entire state highway system. The year 1919, however, closed with a total of ninety-four miles of construction under contract of which seventy miles is open to traffic. The accomplishments to date, including the future program already provided for, are but the results of less than two years' activities, with the efforts of the entire year of 1918 practically nullified, due to the regulations and requirements of the federal authorities, a matter entirely beyond the control of the commission."

SEWERAGE AND SANITATION

Kansas Venereal-Disease Legislation Upheld.

Topeka, Kans.—The Supreme Court of Kansas in a recent decision has declared that the 1917 law for the control of communicable diseases is constitutional and has also upheld the validity of regulations of the State board of health and an ordinance of the city of Topeka regarding venereal disease control. (Ex parte McGee et al., 185 Pac. 14.) The defendants were found to be venereally infected and were ordered quarantined by the city health officer of Topeka, acting under authority of the regulations of the State board of health and a city ordinance. Application was made for a writ of habeas corpus, the defendants attacking the constitutionality of the 1917 law and the validity of the State board of health regulations and the city ordinance. The statute enacted in 1917 gives the State board of health authority to declare what diseases are communicable and to make regulations for their control. Under this act the State board of health declared venereal diseases to be communicable and published regulations for their control. The city of Topeka also passed an ordinance relating to the control of venereal diseases. Under the regulations and ordinance venereally infected persons could be quarantined. The Supreme Court denied the writ. In declaring the law constitutional and the regulations and ordinance valid, the court said:

> The statute is assailed as delegating legislative power to the State board of health. The statute belongs to the well-known class in which the legislature enacts a law in general terms, confers on an officer or administrative body power to enforce the law, and, to accomplish that end, to adopt necessary rules and regulations, and prescribes penalties for violations of the regulations so adopted. (12 C. J., 844, 848.) The necessity for legislation of this character is demonstrated by very recent events. If, when the statute under consideration was before the legislature, it had designated all the infectious, contagious, and communicable diseases it knew, and had prescribed regulations for their suppression and control, it would have omitted the deadly influenza, which soon afterwards made such appalling inroads on the lives and health of the people of the State. To meet emergencies of this character it is indispensable to preservation of th public health that some administrative officer or board should be clothed with authority to make adequate rules which have the force of law, and generally the public welfare is best promoted by delegating power to make administrative regulations to fulfill the expressed intention of the legislature. While in this instance the terms of the statute are somewhat meager, it undertakes to protect public health by preventing dissemination of dangerous communicable diseases through isolation and quarantine measures, nonobservance of which is declared to be a misdemeanor; and the authority given the State board of health to specify such diseases as measure up to the standard of infectious, contagious and communicable and to prescribe appropriate control measures is well sustained. * * *
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> The rules of the State board of health and the city ordinance are assailed as unreasonable. In this instance only those provisions of the rules of the State board of health and of the city ordinance are involved which relate to isolation of persons who have been examined and have been found to be diseased. Reasonableness of provisions relating to discovery and to examination of suspects need not be determined. It may be observed, however, that while provisions of the latter class cut deeply into private personal right, the subject is one respecting which a mincing policy is not to be tolerated. It affects the public health so intimately and so insidiously that considerations of delicacy and privacy may not be permitted to thwart measures necessary to avert the public peril. Only those invasions of personal privacy are unlawful which are unreasonable, and reasonableness is always relative to gravity of the occasion. Opportunity for abuse of power is no greater than in other fields of governmental activity, and misconduct in the execution of official authority is not to be presumed.
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> It is urged that the regulations in question are unreasonable, in that they authorize isolation in remote places beyond the limits of the city in which the petitioners reside. The court knows of no law or rule of public policy or private right which requires a person who, for the protection of the public, must be isolated and treated for loathsome communicable disease to be interned in the locality in which he may reside. It would have been competent for the State board of health to designate a single hospital for the detention of all persons in the State found to be so diseased, and it is entirely reasonable for cities having inadequate facilities or having no facilities of their own to take advantage of those provided by State authority. * * *
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> In the application for the writ it is stated that if the petitioners be diseased they are able to provide themselves with proper treatment in an isolated place in the city of Topeka. The answer is: The public health authorities are not obliged to take chances. * * *

Lowest Death Rate Ever Recorded in New York.

New York City, N. Y.—Dr. Royal S. Copeland, health commissioner, has announced that the year 1919 was the banner health year in the 53 years that the board of health has been organized. "The death rate reached the lowest level ever recorded in this city since the department was organized. The death rate for the year 1919 was 12.39 per 1,000 of the population as compared with the rate of 16.71 in 1918 and 13.94 for the five-year period 1913 to 1917 inclusive," said Dr. Copeland. "The death rate at the time of the organization of the board of health, a half century ago, was a little more than 28 per 1,000 of the population, which, compared with the death rate of 12.39 in 1919 shows a reduction of considerably more than 50 per cent of the mortality of the city. Under the conditions prevailing fifty years ago, two persons would have died where only one died during the past year." A decrease in prevalence and mortality is shown in typhoid fever, typhus fever, malarial fever, whooping cough, measles, scarlet fever, diphtheria, tuberculosis and the diarrhoeal diseases of children. During the year just ended there were 74,433 deaths as against 98,119 deaths in the year 1918, and an average of 83,760 deaths for the five years of 1913 to 1917. "A noteworthy decrease was the unprecedented drop in the mortality from tuberculosis of the lungs," said Dr. Copeland. "It was evident that during the epidemic of influenza that persons suffering from pulmonary tuberculosis were not at all affected by the prevailing epidemic. Apparently tuberculosis conferred a relative degree of protection as against the epidemic of influenza. The mortality rate of infants under one year of age reached the low record of 82 per 1,000 of the children born. This was the lowest infant mortality rate on record for the city. During the past year 39,889 men and 34,544 women died. There were 3,211 deaths of colored persons and 131 deaths of Chinese and Japanese; 31,390 persons died in institutions, 27,839 in tenements, 12535 in private dwellings, 852 in hotels, 1,898 on the streets or in rivers."

Food and Soft Drink Regulation Upheld by Court.

Portland Ore.,—An ordinance of this city regulating food and soft drink establishments has been declared valid by the Supreme Court of Oregon. (City of Portland v. Traynor, 183 Pac., 933.) The ordinance provides for the licensing of food and soft drink establishments if the location and sanitary conditions and arrangements are satisfactory. Employees in such establishments are required to obtain health certificates which are good for three months. The medical examinations of employees are made by the bureau of health, and a nominal fee of 25 cents is charged for each examination. The defendant, who was engaged in conducting a grocery store, refused to obtain a license. He was convicted in the lower courts and the supreme court affirmed the conviction. In the opinion it was said:

> He [the defendant] contends that the "ordinance makes no provision or regulation by which the bureau of health is to be guided in determining in what particular the applicant for license shall be 'physically fit,' nor what requirements must be met to constitute a grocery store 'a suitable place' "; * * *
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> If the premises comply with the ordinance of the city and

> the rules and regulations of the government with reference to plumbing, water supply, ventilation, and cleanliness, the permit must be granted, and the health officer has no right to refuse it. The ordinance of the city of Portland and the rules and regulations of the government in such matters are both definite and certain, and the only question which the board of public health has any authority to consider is whether or not the premises or place of business come within such terms and provisions. * * *
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> It is not within the authority, or even the discretion, of the bureau of health to grant arbitrarily a permit to one person who has complied with the ordinance, rules, and regulations, and deny it to another who has complied with them. In the instant case, as to his place of business, there is no claim or pretense on the part of the city that the defendant has not complied with the city ordinance, rules and regulations. The offense consists in his failure and neglect to pay the required license fee, which he admits he had not paid. * * *
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> The purpose and intent of both the city of Portland and the Government was to control and to prevent the spread of contagious and infectious disease. * * *
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> Under its charter the city of Portland had a legal right to adopt the ordinance here involved. It is not for this court to say whether or not the measure should have been enacted; that is a legislative and not a judicial question. The charter also makes it the duty of the bureau of health to enforce such an ordinance, and vests it with such power to make the necessary rules and regulations for its enforcement.
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> There is no evidence that the requirements of the bureau of health are arbitrary or unreasonable, or that there was any discrimination in their enforcement. * * *

STREET LIGHTING AND POWER

City Wins in Gas Rate Fight.

San Francisco, Cal.—By the decision of Master in Chancery H. M. Wright the city of San Francisco is returned a victor in its controversy with the Pacific Gas and Electric Company. Under his report, if sustained by the court, consumers will receive between $1,500,000 and $2,000,000, which represents the money they paid the gas company in excess of the rate fixed by the city for the fiscal years 1913-14, 1914-15, and 1915-16, plus 7 per cent interest. Wright finds that the rate of 75 cents per 1,000 feet, fixed by the city for the years named, offered a fair return on the investment. When the city fixed the 75-cent rate the gas company declared that an 85-cent rate was necessary for a proper return on its property, the value of which it fixed at $20,000,000. It obtained an injunction, which permitted it to collect the 85-cent rate, and at the same time gave bond, agreeing to return the excess profits in the event the decision went against them. The hearing had extended over three years. The testimony covers 4,000 pages, 1,000 pages of which comprise arguments. There were 111 exhibits. Wright's report covers 150 printed pages. The draft is subject to objections which may be filed for consideration by him. Then it will go to the United States District Court for confirmation or reversal. In the event that it is confirmed, it is indicated that the company will take an appeal to the Supreme Court. In his finding Wright finds that the property of the company was valued at $13,976,000 during the fiscal year 1913-14; $13,986,000 in 1914-15, and $14,416,000 in 1915-16.

To Develop Great Lakes Hydro-electric Power.

Ottawa, Canada.—It is probable that the next great national undertaking upon which Canada will embark will be the development of the St. Lawrence as a waterway from Montreal to Morrisburg so as to make a thirty-foot channel from tidewater to the Great Lakes. Incidentally, it would provide a very large addition to the hydro-electric power of the United States and Canada. Colonel Kellar of the United States War Department, and W. J. Stewart, hydrographer of the Dominion of Canada, appointed to prepare for submission to the international joint commission the whole question of coöperation by the two countries in the development of the navigation and water-power resources of the St. Lawrence, have made a thorough inspection of the river and its banks; and have laid before their respective Governments all aspects of the matter. The scheme, according to the Canadian Bureau of Information in New York, is international and interprovincial, and there is the danger of conflict with very powerful corporate interests. To arrive at an agreement with the United States will take considerable time; to satisfy the conflicting interests of Ontario and Quebec may be still more difficult. These are private interests which will have to be considered and probably eliminated. The preliminary plans provide for four dams, located near Morrisburg, near Cornwall, at the foot of Lake St. Francis, and below the Lachine Rapids. The first two are in international boundary waters, and the two latter in Quebec. The engineers claim that there could be developed as a minimum the enormous total of three million horsepower on a 24-hour service. It is claimed that the four dams will make the necessary deep-water channel, although there will have to be locks at various points of the depth of the new Welland Canal so as to permit all boats capable of passing through the Welland to utilize the St. Lawrence. It is proposed that the canal shall be an international one, the cost, probably between $300,000,000 and $500,000,000, to be divided between the two countries. If the canal can be completed through the St. Lawrence, which will permit ocean-going vessels to traverse the Great Lakes, it will revolutionize the transportation problem of western Canada and the Western States. If vessels can be loaded at Chicago, Duluth, Port Arthur, Fort William and other American and Canadian ports with products which can be taken direct to Europe without reloading at the Atlantic ports, it will mean an enormous saving in freight rates. Ocean vessels of light draft have already gone as far as Fort William; by the new scheme it is hoped to have regular ocean freighters reach the Great Lakes ports. If these vessels could pass through the St. Lawrence and Welland Canal to any ports on the inland lakes it would give a cheaper transportation system to world markets of products of the West through to the Rocky Mountains on both sides of the international boundary. All the northwestern provinces and Ontario in Canada, and the Northwestern and some of the Middle States would be tributary to the new system. It is calculated that it would knock five or six cents per bushel off the cost of transportation of Western wheat to Europe.

Proposed Socialization of Electric Power in Germany.

Berlin, Germany.—A bill is now before the German National Assembly, providing for state ownership of the larger electrical generation stations and transmission lines and plants. Suitable indemnification is to be granted to the present owners. Section I of this proposed law reads as follows:

> The state is authorized to take over the following properties and interests against suitable indemnification: (1) Property in lines and plans which may be employed for the transmission of 50,000 or more volts of electricity and which serve to transmit electricity to more than one motor; (2) property in establishments which produce electrical energy and which are equipped to generate 5,000 or more kilowatts, which are the property of private persons or concerns, and which serve to generate electricity, the larger part of which is not consumed by the same concern; (3) rights of development of electrical energy from water power vested in private persons or concerns, which would have a capacity of 5,000 kilowatts or more; and the electricity from which is not to be used principally by the same concern; as well as all property and rights required for the development of such projects, including rights to use preparatory technical material.
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> Upon request of a federal state, the ceneral government is obliged to take over all such property as belonged to the state in question at the time of the passage of the law, and which answers the prescriptions of the foregoing paragraph. All installations and establishments which form an economic unit with power installations are considered as falling within (2), as described above. The owner may require that such property as would become useless by reason of separation must be taken over by the state simultaneously with the property and rights described in the foregoing paragraph.
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> The law provides further for the establishment of an advisory council which is to he consulted by the government in all matters relating to the carrying out of the law. The Minister of Finance is authorized to employ as much as 1,000,000,000 marks (about $238,000,000 at normal exchange for the purpose of putting the provisions of the proposed law into effect. Inasmuch as the law does not contain any provisions as to how the electrical property is to be administered by the states, the sum authorized may be taken to be the Government's estimated requirements for indemnification purposes. Section 21 provides that a law concerning the administration of the newly acquired electrical property of the state is to be introduced before October 1, 1920.

This measure providing for the socialization of electrical production and transmission is meeting with vigorous criticism from many sides. Part of the opposition is based on the fact that the law leaves the public as well as the legislators entirely ignorant as to how the electrical property will be administered; the law is also criticised on the ground that it is not a monopoly, since it does not prevent the continued private ownership of smaller properties, and on the ground that the method of calculating indemnification is neither trustworthy nor just. The Association of German Engineers, the Association of German Electro-Technicians, the Electrical Works Association of the Union of Electrical Undertakings of Germany, and the Central Union of the German Electrical Institute have directed a joint communication to the president of the National Assembly demanding that the law be submitted to the examination of experts representing the various branches of the electrical industry before being further considered at Weimar. The communication in question characterizes the law as not having been drafted in a thoroughgoing fashion and as being unsuited for attaining the ends which it seeks. In support of the law, Finance Minister Erzberger states that the present coal shortage, which shows signs of continuing for some time to come, requires that the Government do everything possible to conserve heat and energy. The first object of the Government will be to introduce economic administrative systems in many of the plants, with a view to reducing the price of electricity. He believes that the plants as a whole will be better and more economically run under government ownership than at present. The main object of the law, however, is to guard the people against the dangers of private ownership of the large transmission lines and generation stations. Their worth to the people as a whole is too great to permit their remaining in private hands. Another object is to make it possible to establish an effective system of cooperation between the large power-producing groups of Middle Germany, Saxony, Upper Silesia and South Germany.

In the debates which recently took place at Weimar concerning the proposed law, Representative Wieland made a counterproposal, viz., that a limited-liability company instead of the Government should be the future owner of electrical properties, that a nominal dividend should be paid to the owners of shares in this company, and that the balance of profits should go to the state. This company could close all generation stations which do not produce enough electricity to warrant their continued operation, and could combine smaller plants which could be more profitably operated under such combinations. These counterproposals appear to have met with little sympathy and seem to be somewhat out of the general spirit of the trend of affairs at Weimar.

During the debates in the National Assembly at Weimar the Socialist Representative Kahmann stated that of the 4.000 generation stations in Germany only 200 would be taken over by the state; the remainder would not be affected by the proposed law, on account of their small size. The 200 to be taken over generate about 74 per cent of the total electrical energy produced in Germany.

The clauses of the proposed law which prescribe methods of calculating indemnities and those which define the responsibilities of the state in the matter of the carrying out of existing contracts for furnishing power to consumers are rather complicated and have elicited many questions and much criticism.

The proposed law has been referred to a committee of 28 of the National Assembly, and will shortly be returned to the assembly for further consideration.

Urges City Purchase Lighting System.

Akron, O.—The acquisition and maintenance of the street lighting system by the city was suggested by E. A. Kemmler, superintendent of highways, in his annual report to Earl Zeisloft, city engineer. The advantages which will accrue as a result of the city purchasing the lighting system from the N. O. T. & L. Co., as pointed out by Mr. Kemmler, are: "The city would purchase metered power only and thereby save the payment for lamps not in service. The cost of maintenance might not be reduced, but the character of service should be improved. Changes for the betterment of the service by substituting more modern or economic lamps, or by rearranging the distribution system from time to time could be made without present delays. The city will eventually have a municipally owned power plant, and by acquiring the system in the near future, before the five-year contract expires, the change from private to public ownership will be more readily made."

GOVERNMENT AND FINANCE

City Manager Changes.

Bryan, Texas.—J. W. Greer, city manager of this city for several years, has tendered his resignation to the city commissioners effective next month. Greer has accepted the position as city manager of Tallahasse, Florida.

Canadian City Votes for Big Improvements.

Calgary, Canada.—Municipal undertakings amounting to nearly $1,000,000 were voted by the citizens of Calgary at the recent election. The several municipal improvements are: Sewage disposal, $350,000; bridge work $155,978; hospital, $155,000; water-extension system and dam crossing Elbow River, $272,316; making a total appropriation of $933,294. It is the intention of the city to begin the work as soon as possible.

Engineering Department Makes Record on Low Overhead.

Portland, Ore.—The city engineering department during the three closing months of the fiscal year of 1919—September, October and November—completed plans for 102 public improvements, the total cost of which will be $1,500,000. "This is a record for the number of projects handled," said Engineer Laurgaard, "and in doing the work we set a record for lowest engineering costs in the city's history. The costs were but 1.12 per cent of the total." Sixty-one of the 102 plans were for street improvements and 41 for sewer systems.

Financing of Public Works in Italy.

Rome, Italy.—According to the American Trade Commissioner here, H. C. MacLean, both from the standpoint of the public welfare and from that of providing employment for the large number of workers and of discharged soldiers who are unemployed, it is essential for Italy to undertake the immediate construction of public works on a large scale. If, however, the commencement of these works was permitted to await the ability of the Italian Government to provide the necessary funds, much valuable time would be lost, for the financial condition of the Government is such that its expenditures must be reduced to the lowest possible limit. In order to overcome this difficulty there has just been established by royal decree a credit consortium for public works, which will grant loans for the execution of public works. These loans will be secured by the assignment of the annual payments due from the State and the contributions made by the Provinces, Communes, etc. Through the intervention of the consortium the necessary funds will be available at once, without delaying the progress of the work until further payments from the Government become due. The consortium is composed of the Cassa dei Depositi e Prestiti (Office of Deposits and Loans), the Istituto Nazionale delle Assicurazioni (National Insurance Institute), the Cassa Nazionale delle Assicurazioni sociali (National Office of Social Insurance) and of the savings banks which make application for membership. It is an autonomous body, but is subject to the supervision of the Ministry of the Treasury. The initial capital of the consortium is 100,000,000 lire, of which 60,000,000 lire will be subscribed by the Cassa di Depositi e Prestiti. However, as its membership increases, the capital may be increased to 150,000,000 lire. In addition to lending its capital, bonds may be issued by the consortium, guaranteed by the annual payments referred to above; these bonds may be traded in by the stock exchanges, may be accepted as collateral by banks of issue, and may be purchased by banks and other institutions which are obliged to carry all or part of their funds in Government securities. They are subject only to a stamp tax of 10 centesimi, and are exempt from all present and future taxation. Another new institution designed to facilitate the execution of public works is the Istituto per le Opere Pubbliche dei Comuni, which is authorized to take over and carry out public works on behalf of single communes or groups of communes when such works receive financial assistance from the State. In exceptional cases the Ministry of Public Works is authorized to make advances to the Institute of Public Works up to nine-tenths of the amount due, on that portion of the work which can be completed during the year.

MISCELLANEOUS

Truck Restrictions and Reciprocity in Massachusetts.

Boston, Mass.—Nothing in the way of radical change in the motor vehicle law is suggested in the final recommendations for legislation of the Massachusetts Highway Commission. This commission, after a useful existence of twenty-eight years, has been merged with the Waterways Commission in the new State Department Commission of Public Works, but before the merger went into effect its members made their usual annual recommendations for legislation. The commission has always led in shaping the motor vehicle and road laws, and its suggestoins have great weight with the legislature. Most interesting among the suggestions and bills submitted is a move toward further liberalization of the law governing interstate traffic, so as to permit the freer circulation of motor cars and trucks from one state to another.

Under the existing Massachusetts law motor vehicles from other states can stay here for as long a period as their home states permit Massachusetts cars to use their roads. In cases where there is a limti to the non-resident touring privilege, as in New Hampshire, for instance, the car or truck owner frequently crossing the boundary line has to have a registration in both states. But by Massachusetts law, a car or truck cannot legally carry more than one set of number plates, and consequently a strict compliance with the law would necessitate the New Hampshire drivers, upon entering Massachusetts, to take off his New Hampshire plates and substitute for them his Massachusetts plates. This, in practice, is not done, and many motorists are frequently breaking the law.

Regarding this matter the commission says: "The commission believes that it would be wise to enact a statute that would authorize motor vehicles regisered in the adjoining states, which are required by law to be registered also in this commonwealth, to display not only the number plates issued to them here, but also the number plates of their home state. The numbers of both states should be displayed as required by law on the front and rear.

"Under existing laws quite a large number of motor vehicles are required to be registered in two or more states and are continually operated across the border. The law prohibits them from displaying more than one number plate on the front or on the rear. Strictly speaking, they should stop at the boundary line and take off the numbers of one state and put on those of another, or they are liable to prosecution. In practice that would cause a great deal of trouble."

This recommendation, if it becomes law, may open the way toward a general interstate registration system, for which motorists have contended a long time.

After some months' experience with the law that restricts the width and length of motor vehicles using the highways, the commission has decided that it is wise to extend it to cover all vehicles and objects using the roads, including horse-drawn vehicles. The commission also is renewing its recommendation for a restriction in the maximum height of vehicle and load. The height restriction was defeated when the law was passed limiting the width of motor vehicles with load to 96 inches and their extreme over-all length to twenty-eight feet. The height limit that the commission favors is eleven feet. Under the proposed law horse-drawn vehicles which, including the load, were more than ninety-six inches wide, over twenty-eight feet long and over eleven feet high would have to secure a special permit. The restrictions apply also to houses moved over the roads or to any sort of engine or tractor. On this matter the commission states:

> The commission believes that, for the public safety, the length, width and height of all vehicles or objects, which are moved over the highways without a special permit, should be limited by law. The same reasons which caused the legislature of 1919 to place limitations on the dimensions of motor vehicles and trailers apply with equal force to all other vehicles and objects."

This bill may encounter some opposition from owners of horse-drawn and motor trucks. The motor truck owners will object to the height limitation, as they did last year, on the ground that excessive height of load is now limited by the headway under the bridges and under trolley wires, and that where a truck is used under conditions where these limits do not have effect, the weight of load acts as a limit. Where light but bulky loads are carried, such as of empty boxes and barrels, it is contended that a high load is necessary in order to use a truck profitably. Owners of horse-drawn trucks will probably object to the width and length limits.

So much confusion has arisen over the definition of a "trailer" for purposes of registration that it has been found desirable to put on the statute books a clearer definition, and the following is suggested by the commission, as an amendment tothe automobile law: "Commercial trailer shall include every vehicle which is used for conveyance of commodities for use in connection with commerce, which has no motor power and which is moved by a motor vehicle." Under this definition the two-wheeled trailer often used by motor tourists for carrying baggage or camping outfit would be exempt, as it is under the present law. But if a salesman were to use such a device for carrying goods or samples it is likely that it would be considered as trailer and would have to be registered.

Zoning Ordinance for Omaha.

Omaha, Neb.—An ordinance has been prepared by the city planning commission which regulates and restricts the location of trades and industries, locates buildings designed for special uses, regulates the height and bulk of buildings hereafter erected, and regulates and determines the area of yards, courts and other open spaces about buildings, and establishes the boundaries of districts for these purposes. The ordinance has three main parts referring to use districts, height districts and area districts. The use districts regulate and restrict the locations of commerce, business, trades or industries and the location of all buildings designed, erected or occupied for specified uses, and divides the city of Omaha into four sections: (a) residence district; (b) commercial district; (c) industrial district; and (d) unrestricted district.

Under (a) for residence district, all land and buildings in the residence district shall be erected for and used exclusively as dwellings, tenements, lodging or boarding houses, churches, private clubs, hospitals, sanitariums, public or semi-public institutions of an educational, philanthropic or eleemosynary nature, railroad passenger station and the usual accessories located on the same lot with these various buildings. This includes the office of a physician, dentist or other person authorized by law to practice such professions, and includes private garages containing space for not more than four automobiles.

Under (b) or commercial district, all buildings shall be erected and used for stores or shops, for the conduct of wholesale or retail business, places of amusement, office or offices, police or fire department station houses, postoffices, studios, conservatories, dancing academies, carpenter shops, sleeping or dyeing works, public garages, painting, paper hanging or decorating stores or shops, dress making, laundries, millinery stores or shops, photograph galleries, plumbing shops, roofing or plastering establishments, tailoring, tinsmithing, upholstering or undertaking establishments, and also any use permitted in the residence district. Also telephone exchanges, electric substations or car barns may be established in this district, upon permit from the city council. Also upon certain condition the city mouncil may issue permit for a public garage in this commercial district.

Under (c) or industrial district the following industries, trades or uses are prohibited: Ammonia, chlorine, bleaching powder, sulphurous, sulphuric, nitric or hydrochloic acid manufacture, asphalt manufacture or refining, brick tile or terra cotta manufacture or storage, boiler works, creosote treatment or manufacture, crematories, distillation of coal, wood or bones, fat rendering, fertilizer manufacture, illuminating or heating gas manufacture, glue manufacture, gunpowder, fireworks or explosive manufacture or storage, incineration or reduction of garbage, offal, dead animals or refuse, iron foundries, lamp black manufacture, lime, cement or plaster of paris manufacture, paint manufacture, petroleum refining or storage, pickle, sausage or vinegar manufacture, railroad yard or roundhouse, raw hides and skins storage, curing or tanning, rolling mill, scrap iron, junk or rags storage or baling, slaughtering of animals or fowls, smelting of iron, soap manufacture, yards for storing or feeding of stock, stone mills or quarries, tallow, grease or lard manufacture or refining, tar roofing or tar waterproofing manufacture, chewing tobacco manufacture.

Buildings designated and used for all other trades and for purposes of storage, industry, commerce or residence may be erected in this district.

Under (d) or unrestricted district-buildings may be erected and used without restriction as to the nature of their use, provided, the same is not prohibited by law or ordinance.

The height district regulates and limits the height of buildings, and divides the city of Omaha into four classes: (a) 35-foot district; (b) 60-foot district; (c) 100-foot district, and (d) 150-foot district. The area district regulates and limits the area of a lot or plot of gground to be occupied by buildings, and divides the city of Omaha into four classes designated as "A," "B," "C" and "D" districts. "A" district allows that 100 per cent of the area of the lot can be occupied by building; "B" district allows that 100 per cent of the area of the lot can be used on the first floor, and 75 per cent of the corner lot; "C" district allows that 40 per cent of the area of the lot can be occupied by building; and "D" district allows that 25 per cent of the area of the lot can be occupied by buildings. This means that "C" and "D" districts will be used for residence purposes; that "B" district will be used for commercial purposes, and "A" district for industrial purposes.

NEWS OF THE SOCIETIES

Feb. 9-13.—AMERICAN ROAD BUILDERS ASSOCIATION. Annual convention, Louisville, Ky. Secretary, E. L. Powers, [illegible] Nassau street New York.

Feb. 16-18.—INTERNATIONAL CITIES AND TOWN PLANNING ASSOCIATION. Annual meeting, London, England. Honorary secretary, C. B. Purdon, 3 Grays Inn Place, London, W. C., England.

Feb. 20-21.—AMERICAN CONCRETE PIPE ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, G. E. Warren, 210 South LaSalle street, Chicago, Ill.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

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Building Officials Conference.

The Building Officials' Conference will hold its sixth annual meeting in Chicago, February 16, 17, and 18.

Arrangements are being perfected for holding a joint session with the National Conference on Concrete House Construction.

The American Concrete Institute, and the Concrete Products Association will hold meetings in conjunction with the "Conference on Concrete House Construction."

There will be papers and discussions on "The Architect and Design," "Community Planning," "Financing Homes," "Fire Protection," "Monolithic Houses," "Concrete Block," and "Unit Constructed Houses."

There will be separate sessions on Monday, in order to give members time to travel to Chicago on Sunday without taking too much time from their offices. The joint session will be held on Tuesday. Wednesday can be used for unfinished business and further discussions, or for trips.

Headquarters will be at the Auditorium Hotel. Fred W. Lumis, Springfield, Mass., is secretary.

Associated General Contractors of America.

On account of the impossibility of making suitable arrangements for the annual meeting of the Associated General Contractors of America to be held in Chicago, January 20-21, the dates for the convention have been advanced one month to February 18 and 19. The plans for the combined annual meeting and national conference loom so large that the Executive Board believe another month devoted to preparation for this most interesting gathering of construction interests will be well spent. An outline of the tentative program follows.

At the annual meeting (for members only) held on Wednesday morning will be presented annual reports and committees will be nominated.

The National Conference on Construction will begin at 2 p. m. Wednesday afternoon. The two subjects considered will be "The Lump Sum and the Cost Plus Forms of Contract" and "Industrial Relations."

A smoker and entertainment will be held at 8 p. m.

On Thursday morning the business meeting will be continued and will be open to members only. Among the questions taken up will be those of "Organizing the Construction Industry."

The second session of the National Conference on Construction will be held in the afternoon and will be divided into four divisions: Building Contractors, Railroad Contractors, Highway Contractors and Public Works Contractors. The topics taken up by the highway contractors will include "The 1920 Highway Program," "State Highway Contracts" and "Getting Together with the State Highway Department." The public works contractors will discuss "A National Department of Public Works" and "The Budget System."

The annual banquet will be held at 6 p. m. Friday, Feb. 20, will be devoted to special trips to points of interest.

Southern Appalachian Good Roads Association.

The Southern Appalachian Good Roads Association will meet at Asheville, N. C., Feb. 26 to 28, inclusive.

INDUSTRIAL NEWS

Operating Farms for Feeding Garbage to Hogs.

The American Stock Food Co., Grand Rapids, Mich., has entered into a five year contract with the city of Akron, O., for the disposal of all its city garbage. The contractors will establish a hog farm ten miles from the center of the city on about 200 acres of land. The garbage will amount to about 50 tons per day and will be delivered by the city in motor trucks.

The company is also operating hog farms under contracts with the cities of Grand Rapids, Mich.; Alma, Mich.; Highland Park (Detroit), Mich.; Mansfield, O., and Wheeling, W. Va.

At Wheeling this company has recently finished what it calls a "hotel de swine" with a capacity for feeding and lodging 2,000. The hogs are not allowed to go out, and the whole plant is roofed over. This is said to be the only establishment of its kind.

The Sullivan Machinery Co., Chicago, Ill., announces with regret the death, Dec. 14, of Charles Keith Blackwood, vice-president, assistant treasurer and auditor of the company. Mr. Blackwood's sound financial judgment, with foresight and executive ability had been important factors in the company's growth during the past seventeen years and his loss is sincerely deplored by his associates.

The company announces the following appointments by the board of directors: Arthur E. Blackwood, formerly manager at New York City, to be vice-president in charge of finance and accounting; Howard T. Walsh, vice-president, in charge of sales; Gilbert K. Wilson, asssistant secretary, in charge of cost accounting; Nathaniel H. Blatchford, Jr., assistant treasurer; Emil A. Krevis, general auditor; Frederick W. Copeland, manager of foreign sales. Louis R. Chadwick, for a number of years manager of the company's office at Spokane, Wash., has been appointed manager at New York City, 30 Church street, succeeding Mr. Blackwood. Robert T. Banks, for several years associated with this company as sales engineer at its El Paso, Tex., office, has been appointed manager at Spokane to succeed Mr. Chadwick.

The Standard Point Company, New York, N. Y., announces with regret the death of its president, Ralph L. Shainwald, on Dec. 10, 1919.

"The Story of the Tire."

So widespread has been the demand from schools and colleges for the booklet "The Story of the Tire," issued for free distribution by **The Goodyear Tire & Rubber Company,** Akron, O., that a second edition has been necessary and is just off the presses. Eight thousand institutions of learning, from coast to coast, are using it as a reference work and text book. It is also included in the libraries of many cities.

The value of this booklet is that it is not designed as an advertising or publicity feature, but tells a plain story of the romance of rubber from the time a tree is planted in the tropics to its ultimate mission of playing an important part in the world's transportation as a tire.

A foreword emphasizes the fact that rubber occupies a position as a world's necessity second only to that of steel. The planting, gathering, and shipment of crude is interestingly told and the manufacturing processes tracing the crude rubber from its arrival in America to its utilization as tires on bicycles, airplanes, automobiles and motor trucks are detailed in a fascinating story that is amazing to the uninitiated.

Rubber and cotton plantations, the early development of tires, manufacture of inner tubes and the care of tires are treated interestingly and authoritatively in other chapters.

"The Story of the Tire" is profusely illustrated with photographs that bring home vividly the story and far places connected with the romance of rubber. It is intended for distribution among students, teachers, schools, colleges, libraries and everybody interested in rubber. In fact it was inspired by the numerous requests for information about rubber from all parts of the world.

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"
Vol. 48 NEW YORK, FEBRUARY 7, 1920 No. 4

Resurfacing Old Pavements

Resurfacing of pavements is the most important and difficult of the problems before the highway officials of the larger and older cities, and is rapidly becoming so for the others as well. With this article we begin a series dealing with this subject, this being a general review, briefly touching upon all of the standard kinds of pavement.

A total of $435,000 spent for new construction; but $1,437,000 for maintenance and reconstruction.

The above figures, from the 1919 annual report of the Connecticut Highway Department, are significant and interesting, not because they are peculiar to that state, but rather because they are typical of all the states and cities where paving has been going on for ten years or more.

When a city or a state begins a paving program, the people and frequently the officials themselves are apt to so concentrate their thoughts and efforts upon *construction* as to overlook the fact that the pavements they are constructing, no matter how good the material or workmanship, will some time wear out and need repairing and replacing.

WHEN RESURFACING IS NECESSARY.

The length of the period before resurfacing or reconstruction becomes necessary varies, of course, with the kind of pavement and nature of traffic. A hard-surface pavement on a concrete base will ordinarily last longer, even under heavy traffic, than a gravel or plain macadam road under ordinary present-day traffic. The time when repairing or resurfacing is undertaken also varies more

RESURFACING SHEET ASPHALT ON FIFTH AVENUE, NEW YORK.

Removing Sheet Asphalt Surface Without Stopping Traffic, San Francisco.

or less with the class of surface material employed. For instance, sheet asphalt, bituminous concrete or similar pavements constructed of aggregates bound with bitumen or water can be patched and repaired when slight inequalities have been caused by wear. A block pavement, however, such as clay block or brick, stone block, or wood block, cannot be patched so readily and if constructed of uniform material ordinarily will not need attention so soon, and repairs to such pavements are generally deferred for a much longer time.

Most cities except the newest have already found some of their streets reaching the point where something must be done to put them into reasonably good condition. If a good concrete base was used, it will not generally be necessary to disturb this, but the old surface can be removed and replaced with a new one of the same or a different kind. Or if the pavement is one composed of aggregates, it may not be necessary to remove all of the old surfacing material. Another method of treatment is to use the old pavement, surface and all, as a base for a new wearing material, which new surface is usually a sheet asphalt or bituminous macadam.

Of the several hundred cities reporting to "PUBLIC WORKS" the kind and amount of paving work done during 1919, a considerable majority report having resurfaced some of their streets. In many of the older cities practically all of the paving was resurfacing, if we include in resurfacing all paving which does not disturb the original base. As the older and larger cities have now paved practically all of their streets, using a concrete base under most of the pavements, practically the entire paving work in such cities in the future will be resurfacing, except for the small amount of new paving on street extensions and in newly opened-up districts which may develop from year to year.

A reference to the table in this issue will show many interesting cases of resurfacing and will give a good general idea of the more prevalent methods of performing such work. We will give in the following paragraphs a summary of some of the more salient features of the information submitted and also describe at length some of the methods employed.

RESURFACING MACADAM.

The kind of pavement appearing most commonly in the reports of resurfacing is naturally water-bound macadam, both because this pavement is in more common use than any other and also because it is being worn out more rapidly by auto truck traffic than almost any other. In many cases, of course, the entire pavement is being taken up and replaced with another pavement having a concrete base. An increasing number of paving engineers, however, are coming to the conclusion that a macadam pavement which has been down for a number of years has become so thoroughly compacted, together with the subsoil under it, that it furnishes as substantial a support as would a new concrete base.

The most common method of resurfacing macadam is by the use of bituminous concrete, although there are numerous instances of the use of sheet asphalt, brick, and most of the other kinds of surfacing materials.

Preparing the Old Surface—Macadam which has been worn so far as to need resurfacing generally contains a number of pot-holes and less serious depressions, and sometimes there has been a general removal of the entire centre of the roadway by wear. This condition of non-uniform surface is found in other pavements as well, and in all such cases the general principle should be adopted of bringing the old pavement, which is to be used as a base, to a uniform surface before applying the wearing course. This is, of course, imperative where a brick or other block pavement is to be laid, but it is almost equally necessary where sheet asphalt or other bituminous material is to be used. The reason for this is that all bituminous surface compacts more or less under traffic, and the extent of this compacting varies with the thickness of the material. Consequently, if the pot-holes were filled with the bituminous surface material, such material at these points would compact more than where the thickness was less, and depressions would form over the original pot-holes. For this reason it is desirable that all such holes and depressions be filled with a material just as stable and incompressible as the balance of the old pavement; also, that the old pavement be so treated with this material as to produce a surface parallel to the proposed surface of the new wearing course, giving a uniform thickness to such course.

Rolling New Sheet Asphalt Surface. San Francisco.

For surfacing the old pavement two general methods are employed, one being to leave all of the old material and fill up the depressions with new; the other being to loosen up the top two or three inches of the old macadam by scarifying, bring the loosened material to the desired grade and surface, and compact thoroughly by rolling. Where the grade of the old pavement is not such as to permit placing the new wearing material upon it without bringing the grade of the street too high, it becomes necessary not only to scarify the macadam, but also to remove some of it, in which case the scarifying must ordinarily be carried deeper in order that a little loose material may be left after removing that necessary for the lowering of the grade.

There is the objection to scarifying that it results in a top course of the old pavement which has been disturbed from its original compacted condition and therefore, no matter how thoroughly rolled, will be subject to a slight future settlement. For this reason it would seem desirable, where it is not necessary to remove some of the macadam, to leave this undisturbed and to fill in the depressions with a material equally incompressible.

Leveling Up—The material used for leveling up macadam is perhaps most frequently bituminous concrete, although cement concrete could be used for the same purpose. In view of the fact that, no matter how thoroughly rammed or even rolled the patches of bituminous concrete may be, they are still subject to more or less settling, while cement concrete when once set will not settle, the writer would prefer the use of the latter material in cases where an old macadam is used without disturbing the surface.

No matter what material is used for leveling up, all dust and loose material should be swept from the depressions and it is perhaps desirable even to wash them out, but without using jets of water having sufficient velocity to disturb the compacted material. The new material should bond firmly with the old pavement, and it cannot do this if there be dust between them.

Where the resurfacing is to be merely a surface treatment, such as covering with oil and a sprinkling of sand or screenings, more care must be taken with the patches. The method employed in Wellington, N. J., as reported by Borough Engineer Anton L. Pettersen, illustrates the best practise. His description is as follows:

"Those parts of the pavements where holes appeared were cleaned and all loose stone and dirt removed. The sides were then cut vertical and the holes filled with broken stone of sizes from 2½ to one inch, which were thoroughly tamped until solid. This new stone was then painted with a light coat of Tarvia K P, using from one-quarter to one-half gallon per yard. On top of this was placed another mixture consisting of one part sand to three parts of ¾-inch stone, together with Tarvia K P, enough of this being used to level up the hole or depression after it had been tamped thoroughly with a heavy iron tamper. When the added material had been thoroughly tamped and made level with the rest of the pavement, a light seal-coat of Tarvia K P was applied and covered with screenings. Great care must be taken to see that not too much Tarvia is used; it is preferable to use too little rather than too much."

Cement concrete is used in Rochester, N. Y., for filling all but minor inequalities in the surfacing. The proper crown is obtained by removing the necessary amount of old macadam, and any depressions remaining in the newly graded surface are filled with 1:2½:5 concrete.

A typical instance of entirely redressing the old macadam by scarifying is offered by Norristown, Pa., where Borough Engineer S. Cameron Corson employs the following method: The old macadam is scarified deep and all excess dirt is removed by forking over the loosened macadam, the stone so cleaned of fine material being used again. After the scarified stone has been removed, crushed slag is spread over the remaining macadam and rolled, and the old macadam stone, free from dirt, is spread over this and the whole is rolled. This pavement was surfaced with Tarvia macadam.

In some cases where the surface needs quite a little shaping, a scraper is used for bringing the loosened macadam to the proper grade and surface. In all cases where the road has been scarified, it is especially desirable to roll it thoroughly with a heavy roller so as to compact it as completely as possible.

Old Concrete Base Resurfaced for a New Sheet Asphalt Top.

Removing and Cleaning Bricks by Means of Compressed Air. Troy, N. Y.

Macadam Reinforced with Brick. Lincoln Highway, Illinois.

Where macadam so resurfaced is used as a base for sheet asphalt, a binder may be placed upon the macadam, or in some cases the macadam is painted and the asphalt wearing surface applied directly to it. Where brick or other block is laid, either a sand cushion or a sand-cement mortar course is spread upon the surfaced macadam.

PREPARING CONCRETE BASE.

In using an old concrete base where this was originally well constructed, it is ordinarily necessary only to remove the sand cushion or other material in immediate contact with the base. If asphaltic material is to be placed directly upon the base, it is generally desirable to clean this thoroughly so as to enable the new material to adhere to it. If the new wearing course is of less thickness than the old (as in the case of replacing stone block with brick, or either of these with sheet asphalt), concrete of the desired thickness should be spread over the old base, the surface of the latter being not only swept but also thoroughly washed by hose and left saturated with water when the new concrete is applied. All depressions or bad spots in the concrete should be filled with new concrete. Wherever new concrete is added to the old, the old concrete should be thoroughly wet and preferably given a thin coat of cement mortar before adding the new material.

COVERING BRICK OR BLOCKS.

A practise which is coming into more general use is that of placing a wearing surface of sheet asphalt or bituminous concrete on an old brick or stone block pavement without removing the old wearing material. This is practicable only when the old material has worn down to a depth below the established grade of the street equal to the thickness desired for the new wearing surface, or where it is possible to raise the street grade an inch or two. In this work, the old block surface is treated in the same way as the concrete base—it is thoroughly cleaned of all dirt and loose material and all depressions having a depth of one inch or more are filled with cement concrete to bring them up to the general level of the old pavement. In one city at least, where the brick pavement had been laid with a sand filler, the filler was raked out to a depth of two or three inches from all of the joints and these joints filled with cement grout.

Several cities in the Middle West still have brick pavements laid twenty years or more ago by the so-called two-course method, the base consisting of a layer of brick, generally laid on the flat side. Several of these have been resurfaced during the past year by taking up the wearing surface of brick and leaving in the base course of brick, this latter being leveled up where necessary by the use of cement concrete and used as a base for a new brick surface.

RE-USE OF BRICK AND BLOCK.

Several cities report resurfacing old brick pavements by using the old bricks over again, the bricks being removed and culled, the base put in condition and the old brick relaid, what was the bottom of the brick being

Covering Old Brick Pavement With "National" Bituminous Surface.—New Haven, Conn.

now placed on the top. The old bricks should be used continuously so far as they will go, and the new brick employed to make up any deficiency occasioned by the rejecting of culls should all be concentrated in one point.

The practise has become quite common of relaying stone block pavements by taking up the blocks, breaking them in two and forming a new face to be used for the top surface. Several instances of this have been described at some length in "Municipal Journal" during the past two or three years.

RESURFACING SHEET ASPHALT.

In resurfacing sheet asphalt, the more common method is to entirely remove the old asphalt by prying it up from the concrete base, and relay a new wearing surface in exactly the same way as in new construction. Quite a considerable amount of resurfacing has been done recently, however, by removing only the top half-inch or so of the old sheet asphalt. This has been done to the extent of thousands of square yards in Brooklyn and Manhattan Boroughs, New York, during the past year. A detailed description of this work will be published within the next two or three weeks. In general, it may be said that the old sheet asphalt is heated by a hot air blast, thus softening it so that it can be removed by means of a hoe. The top surface is so removed to the depth of about a half inch, and while the asphalt surface is still warm, a new asphalt surface mixture is spread and rolled, a sufficient thickness of new material being used to give a finished depth of about one inch. This resurfacing in Brooklyn last year cost an average of $1.75 per square yard, whereas a new pavement on a six-inch concrete base cost $4.01 per square yard. The same treatment was employed in Manhattan Borough for resurfacing asphalt block.

A few cities report resurfacing old wood block pavement, the old block being removed and a new block of the same or some other material laid in place of it.

The above is merely a brief outline of what is coming to be the most important duty of municipal paving departments—the keeping of paved streets in good condition. As already stated, most progressive cities have already paved a large percentage of the streets already opened and lying within their boundaries, and new paving for the future will be confined to a considerable extent to newly opened streets and to those existing in areas annexed from time to time to the city. We expect to publish during the year 1920 a considerable amount of information valuable for paving engineers and superintendents, concerning this important subject of maintaining and resurfacing pavements.

Annual Paving Statistics

Facts and figures from several hundred cities concerning the amount and nature of work done by each during 1919, the cost of each class of pavement, whether laid by contract or by municipal forces, and specially complete data concerning resurfacing—the age of pavement, nature of traffic it had carried, materials and methods employed in resurfacing, etc.

It has been our practice for many years past to give, in February of each year, figures and other data relative to the paving done during the previous year by cities throughout the country. This issue is our "Annual Paving Number," and we are confident that readers will find it unusually rich in valuable information. The data have been furnished by city engineers and other officials in charge of paying in response to questionnaires sent by us, and are official and up-to-date.

So voluminous is the matter received, that only a part of it can be given in one issue. Consequently data have been tabulated only from those cities whose replies were in hand several days ago. Information from several hundred other cities will be given in later issues.

Ten of the twelve tables refer to the amounts and costs of specified kinds of pavements, one to the resurfacing of old pavements, and the twelfth to labor conditions in the several cities, and whether pavements were laid by city forces or by contract. In all of the information, the pavements referred to are those within the city limits.

Quantities are given in either square yards or miles—the size of the figure clearly shows which unit is referred to. Cost is per square yard, and includes base but not grading or other features of street improvements, unless otherwise designated. Where the base is not included in the cost, informants were asked to give the cost of the base.

In Table No. 7, the question was asked: "Did the pavement carry residence or business traffic?" Where the answer "Both" is given, it refers to these two classes of traffic.

The first column in Table No. 12 is in answer to the question: "By what percentage was the cost of the different kinds of pavement higher in 1919 than before the war?" The second column, to the question: "About how many unskilled laborers will be available for contract work in 1920, in the city and vicinity.

It is believed that the headings to the other columns are sufficiently explanatory to need no amplification.

In addition to supplementary tables, summaries of the information given in them will be published at intervals.

TABLE NO. 1—SHEET ASPHALT LAID IN CITY STREETS DURING 1919.

City and State.	Yards or miles laid	Average cost per sq. yd.	Base: Kind	Base: Thickness inches	Base: Cost	Surface Thickness inches	Binder Thickness inches
Connecticut							
New Haven	53,545	$1.70m	1:3:6 Concrete*	6	$0.77	1½	1½
Florida							
Tampa	3,000	2.00n	Shell	5	....	1½	...
Illinois							
East St. Louis	3,158	1.85mn	Concrete on old base	4½	8.45†	2	1
La Grange	13,000	2.53	Concrete on old macadam	4	....	1½	1½
Peoria	5,000	1.75mn	Old trick	..	....	1½	1
Indiana							
Elkhart	3	2.87n	Concrete	6	....	1½	1
Fort Wayne	82,410	2.10n	1:2:4 Concrete	..	....	1½	1
Marion	6,263	2.70m	Old concrete	6	....	2	1
South Bend	63,551	2.97	Concrete	5	....	1½	1½
Iowa							
Creston	20,900	3.37	Concrete	4	....	1½	1
Emmetsburg	73,000	2.75n	Concrete	4 & 5	....	...	...
Kentucky							
Louisville	38,048	3.90	Concrete	6	....	1½	1½
Massachusetts							
Brockton	8,548	1.85m	....	..	....	...	2
Springfield	39,000	1.75	Old macadam	..	....	1	1½
Michigan							
Flint	130,000	4.00	Concrete	6	....	...	1
Lansing	58,000	3.05	Concrete	6	....	...	...
Midland	13,133	1.79mn	Old macadam	..	....	1½	1
Midland	6,188	2.945n	Concrete	6	....	1½	1
Missouri							
Kansas City	86,278	3.88	Concrete	5	....	1½	1½
Nebraska							
Lincoln	6,076	...	Concrete	..	....	2½	1½
New Jersey							
Camden	18,000	3.80	....	..	....	2½	1½
Jersey City	50,016	2.15	Concrete	5	....	2	1½
New Brunswick ..	45,350	3.10n	1:3:6 Concrete	..	....	2	...
Passaic	16,550	3.25n	Concrete	6	....	3	6
Jersey City	36,335	1.98n	Old stone block	..	....	2	1½
New York							
Albany	5,839	3.17n	Concrete	6	....	2	1
Brooklyn	14,760	4.01	Concrete	6	....	2	1
Rochester	105,990	1.60mn	1:2½:5 Concrete	6	....	2	1
North Carolina							
Fayetteville	21,000	3.18	Concrete	5	....	1½	1½
Statesville	15,000	1.30mn	1:3:6: Concrete	5	....	...	...
Ohio							
Columbus	17,159	3.50n	Concrete	6	....	2	1
Fremont	4,420	4.15	Concrete	6	....	1½	1½
Lima	12,187	3.12n	Concrete	6	....	2	1
Toledo	11,927	3.40n	Concrete	6	....	1½	1½
Oklahoma							
Oklahoma City ...	50,388	2.40n	Concrete	4	....	...	...
Pennsylvania							
Erie	120,764	2.38	Concrete	5	1.07	1½	1½
Philadelphia	103,574	2.865	Concrete	6	....	1½	1
Pittsburg	1,830	3.42n	....	6	....	1½	1½
Reading	14,664	3.63	Concrete	6	....	1½	1½
		3.18	Concrete	4	....	1½	1½
Scranton	4,352	2.68	Concrete	6	....	2	2
Tennessee							
Jackson	18,000	2.67	1:3:6 Concrete	5	....	1½	1½
Texas							
San Antonio	46,000	1.25mn	Gravel	6	0.75	2	...
San Antonio	4,420	0.54mn	Gravel	6	0.75	1	...
Utah							
Ogden	42,635	2.58n	Concrete	6	....	1½	1½
Virginia							
Covington	43,956	2.15	Concrete	5	....	1½	1½

TABLE NO. 2—BRICK PAVEMENT LAID DURING 1919 (Continued).

Ohio							
Akron	1.40	3.90	Concrete	6	...	1	Cement
Ashland	10,990	3.84	Concrete	5	1.50	1½	Tar or sand
Columbus	20,127	3.55n	Concrete	6	...	...	Grout
Conneaut	1,573	3.65n	Concrete	5	...	...	Cement
Coshocton	20,000	3.00	Gravel	8	...	1	Tar
East Palestine ..	11,000	2.75n	Furnace slag	6	...	1	Sand
Fremont	3,800	3.31n	Concrete	4	...	1	Sand
Lakewood	7,120	3.60n	Concrete	4	...	...	Cement
Lancaster	2,800	3.07n	Rolled gravel	6	...	1½	Asphalt
Niles	17,000	2.26n	Slag	6	0.75	2	Grout
Sidney	47,215	3.13	Concrete	6	1.00	2	Cement
Toledo	5,141	3.62n	Concrete	6	...	1	Mastic
Zanesville	19,800	3.55n	Concrete	6	...	1½	Asphalt
Oklahoma							
Oklahoma City ..	662	3.35n	Concrete	4	...	1	...
Bartlesville	14,000	2.23mn	Concrete	5	...		...
			Cinders	6	...	1½	...
Pennsylvania							
Altoona	1,392	3.80m	1:3:6 Concrete	5	...	...	...
Archibald	9,000	3.53	Concrete	6	...	1½	Cement
Carlisle	3,550	1.06	Concrete	4	...	...	...
Clearfield	3,600	2.50	Concrete	6	...	2	Tar
Greensburg	3,354	3.03	Slag	7	...	1	Cement
New Castle	0.50	3.85	......	6	...	...	...
North Braddock .	701	4.70	Concrete	6	...	1	Sand
Philadelphia	8,327	4,163	Concrete	6	...	½	Cement
Pittsburgh	48,372	3.55n	....	6	...	...	...
Rankin	3,500	3.65††	Concrete	6	...	1	Grout
Reading	2,240	4.99	Concrete	4	...	¾	Grout
Williamsport ...	3,896	3.71	Concrete	6	...	...	...
Windber	5,089	3.85	Concrete	6	...	1½	Carey
Texas							
Dallas	2,503	3.25	......	6	...	½	Asphalt
Virginia							
Covington	720	3.10	Concrete	4	...	...	...
Covington	719	4.50	Concrete	4	...	...	...
West Virginia							
Grafton	1,114	....	Concrete	...	...	...	...
Wisconsin							
Grand Rapids ...	4,800	2,785n	Concrete	5	...	1½	Asphalt
Kenosha	63,519	3.00†‡	Concrete	5	...	1½	Asphalt
Madison	8,256	1.85mn	1:3:5 Concrete	6	1.10	1	Cement
Portage	10,000	1.50	Sand	...	...	...	...
Racine	50,000	3.16	Concrete	5	...	2	Asphalt

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n Does not include grading or other work. m Does not include base.
†Between and 20 inches outside of trolley tracks.
*Does not include sand for cushion and grout. ‡Does not include gravel and sand.
††Includes all work except grading.
‡‡Exclusive of grading, curb, and gutter.

TABLE NO. 3—GRANITE OR OTHER STONE BLOCK LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cost per sq. yd.	Base: Kind	Base: Thickness inches	Base: Cost	Base: Kind of filler
Kentucky						
Louisville	12,902*	$2.74	Concrete	6	....	Portland Cement
Massachusetts						
Brockton	14,314†	2.20m	Sand	..	....	Cement
Lowell	0.1021	...	Sand	..	....	Cement grout
Lowell	0.2699	...	Concrete	6	....	Cement grout
			Hassam	1	....	....
New Bedford	16,915	6.50	Sand Cushion	1½		Cement
Peabody	2,952‡	4.12	Cement	4	....	1:1 Cement
			Sand	2	$1.65	grout
Springfield	10,000*	6.25	Concrete	5	....	Cement
Watertown	10,102	5.42n	Concrete	6	....	1 in. sand
Missouri						
Kansas City	26,037	7.86	Concrete	10	....	....

Wisconsin							
Beloit	37,000	2.07n	Concrete	5	....	1½	1
Kenosha	23,661	2.50	Concrete	5	....	1½	1
Madison	11,084	1.85mn	1:3:5 Concrete	6	1.10	2	1
Madison	7,327	1.72mn	1:3:5 Concrete	5	1.00	1½	1
Racine	35,000	2.75	Concrete	5	....	2	1
Canada							
Charlottetown,	10,000	1.39mn	....	6	1.50	...	2

*Old macadam except 800 yards. †Cost per cubic yard. m Does not include base. n Does not include grading or other work.

TABLE NO. 2—BRICK PAVEMENT LAID IN CITY STREETS DURING 1919.

City and State.	Yards or miles laid.	Average cost per yard.	Base: Kind.	Base: Thickness, inches.	Base: Cost.	Depth of cushion, inches.	Kind of filler.
Alabama							
Selma	5,600	$2.01n	Concrete	2	...	2	Cement
Connecticut							
New Haven	5,702	4.00mn	Old concrete	...	...	1½ in. mortar	Grout
Georgia							
Griffin	60,000	2.60n	Sand and cement	...	...	1	Cement
Illinois							
Alton	15,750	2.75n	Concrete	5	...	...	...
East Moline	6,000	4.05n	Concrete	5	...	1	Cement
East St. Louis ..	13,223	2.31n	Concrete	6 and 7	...	⅝	Concrete
Gillespie	0.75	3.00n	Brick	4	...	none	Cement
Joliet	18,300	2.80n	Concrete	5	...	1½	Asphalt
La Grange	700	3.20m	Old macadam	...	...	1½	...
Peoria	4,500	2.60n	Concrete	4	...	1	Asphalt
Indiana							
Crawfordsville ..	2,410	2.75	Cement	4	...	1½	Cement
Elkhart	0.50	2.70n	Concrete	4	...	...	Cement
Fort Wayne	4,658	4.00n	Concrete	...	...	1	Cement
Greenwood	4,300	3.50n	Concrete	6	Grading $0.75	1	Cement
Lafayette	1,712	3.50	Concrete	4	...	1	Cement
Terre Haute	3.02	3.25	Concrete	5	...	1½	Cement
Iowa							
Clinton	11,000	4.15	Concrete	5	...	1½	Asphalt
Creston	11,000	4.09	Concrete	5	...	1½	Asphalt
Davenport	5,000	3.40n	Concrete	5	...	1	Asphalt
Dubuque	19,504	3.40n	Concrete	5	...	1	Asphalt
Mystic	8,000	5.10	......	6 and 7	...	1½	Sand
Kansas							
Atchison	19,000	3.80	Concrete	5	...	1	Asphalt
Council Grove ...	35,000	3.26m	......	5	...	1½	Asphalt
Salina	0.38	3.78	Concrete	6	...	1	Asphalt
Winfield	2.00	3.25n	Concrete	4	...	1	Asphalt
Kentucky							
Louisville	1,831	2.31	Concrete	6	...	6	P. C.
Maryland							
Cumberland	13,970	5.25	Concrete	5	...	...	...
Massachusetts							
North Adams ...	735†	2.24	None	...	...	1	Pitch
Michigan							
Ionia	3,716	2.15mn	......	6	0.92	1½	Cement
Midland	834	3.49n	Concrete	6	...	1	Cement
Missouri							
Kansas City	39,269	4.98	Concrete	8	...	...	...
Sedalia	18,294	2.21m	Concrete	6	...	1½	Asphalt
Nebraska							
Lincoln	9,470	3-in. 3.34 4-in. 4.07	Concrete	5	...	1	Asphalt
New Jersey							
Bound Brook ...	630	5.00	Concrete	6	...	1	Cement
Plainfield	14,610	4.09n	Concrete	6	...	...	...
New York							
Albany	419	3.04n	Concrete	6	...	1½	Grout
Binghampton	9115	3.32	Concrete	6	...	½	Grout
Elmira	8,922	3.71	1:2½:5 Concrete	5	...	1½	Pitch
Geneva	10,000	4.30n	Concrete	5	...	1½	Cement
Niagara Falls ...	691	5.11	Concrete	6	...	½	Grout
Olean	37,000	2.00mn* 2.25mn	Concrete	5	$6.10‡ 6.50‡	1½	Cement Sand
Rochester	1,650	2.15mn	1:2½:5 Concrete	6	1.50	1	Grout
Salamanca	6,350	4.85	Concrete	6	...	1	Asphalt

New Jersey						
Bound Brook	1,200*	5.00	Concrete	6	....	Cement
Camden	11,600	6.00	....	..	....	....
Jersey City	2,000§	2.44	Concrete	6	....	Cement
New York						
Binghampton ...	1,589	6.87**	Concrete	8	....	Tar
Brooklyn	0.78	5.61*	Concrete	6	....	....
Fairport	738	4.25mn	Concrete	5	....	Cement grout
North Carolina						
Asheville	3,487	3.47*	Concrete	5	....	Cement grout
Ohio						
Akron	1.24	5.90	Concrete	5		....
Lakewood	31,650	3.70mn	Concrete	6 & 7		....
Pennsylvania						
Hazelton	10,030	1.93	Reconstructed Macadam	..	....	Amesita
Philadelphia	1,892	5.99*	Concrete	6	1.96	Bituminuous mostic
Pittsburgh	28,350	4.95n	....	6	....	
West Homestead.	0.50	6.34n	Concrete	6	....	Cement grout Grout
Rhode Island						
Pawtucket	13.700	5.93	Concrete	6	....	Cement grout
Pawtucket	3.646††	3.75	Concrete	6	....	Cement grout
Indiana						
Portland	9,500	2.60	1:2½:5Concrete	6-8	....	....

*Includes grading.
†Does not include cost of old blocks used.
‡Old Philadelphia blocks turned.
§Belgian on concrete pavement with 1 in. cushion.
**$7.10 in R. R. area.
††Old granite, recut and relaid.
m Does not include base.
n Does not include grading or other work.

TABLE NO. 4—MISCELLANEOUS PAVEMENTS LAID IN CITY LIMITS DURING 1919.

City and State.	Kind of Pavement.	Yards or miles laid.	Aver. cost per sq. yd.	Remarks.
Connecticut:				
New Haven....	National.	22,866	$2.04-2.19 3.36	Resurfacing old mac. On 6-inch concrete.
Florida:				
Tampa	3-inch asphalt block.	5,579	2.47n	
Illinois:				
Granite City....	4½-inch conc. sidewalk.	9,000	1.755	
Indiana:				
Bluffton	Asphalt block.	11,254	1.53	
Noblesville	Concrete sidewalks.	1,400	1.3	
Kentucky:				
Covington	Kentucky rock asphalt.	1,600	2.90n	
Maine:				
Rockland	Lime ashes.	24,620	0.14	
Missouri:				
Sedalia	3-in. vertical fibre brick.	2,000	3.00	Cushion ½ inch on 4-inch concrete base.
New Jersey:				
Collingwood ...	Concrete gutter.	10,000	2.00	
West Orange...	National on 5-in. broken stone.	4,060	2.65	
New York:				
Brooklyn	Asphalt block.	0.13	2.96	Laid on old conc. found'n
Niagara Falls..	Concrete repairing.	4,982	3.80	
North Carolina:				
Fayetteville ...	Sheet asphalt surfacing.	25,000	1.60	
Greensboro	Willite.	2,500	1.40	Exclusive of preparation of base 15c. per yd.
Pennsylvania:				
Freeland	Amiesite 2 inches thick.	6.085	2.861	With concrete base.
Miners Mills ...	Hastings' asphalt block	4,000	4.25	Concrete base.
Philadelphia ...	Split granite, redressed.	13,847	2.36	Cement grouted.
Pittsburgh	Asphalt block.	4,571	4.25n	
Texas:				
Beaumont	Oyster shells.	9,000	0.60	
Dallas	Uvalde rock asphalt.	14,918	2.60	
Washington:				
Aberdeen	Plank.	1,643	1.38	Some elevated.

ⁿDoes not include grading or other work.

TABLE NO. 5—CONCRETE PAVEMENT LAID IN CITY STREETS DURING 1919.

City and State.	Yards or miles laid.	Average cost per sq. yd.	Number of courses.	Thickness, inches.	Proportions of mixture.
Alabama:					
Anniston	1,500	$2.00n	..	..	1:2:3
Colorado:					
Boulder	2,700	2.57a	1	6	1:2:3½
Longmont	15,000	1.62	1	6	1:2:4
Connecticut:					
New Haven	12,270	1.935n	1	6	1:2:4
Putnam	8,000	2.30m	1	7	1:2:3½
Georgia:					
Madison	29,000	3.15n	1	6-8	1:2:3
Illinois:					
Alton	576	2.55n	1	7	1:1½:3
East St. Louis	4,646	3.15n	2	9	1:1:1½ & 1:2½:4
Naperville	56,000	2.11b	1	6-8	1:2:3
Urbana	20,000	2.70n	1	7¼ average	1:2:3
Indiana:					
Lafayette	800	1.65	1	6	1:4½
Marion	427	....	2	6	....
Noblesville	810	2.10	1	7 average	1:2:3
Peru	100	1.75	1	..	2:4:6
Portland	1,600	2.50	1	..	....
Seymour	18,000	2.70	1	6-8	1:2:3
South Bend	3,068	2.271	1	7	1:2:3
Terre Haute	1.61	2.76	2	8-9	1:2:4
West Lafayette	550	1.80	1	6	1:5 gravel
Council Grove	2.580	2.00n	1	6	1:2:3
Iowa:					
Creston	2,500	3.18	1	6	1:1½:2½
Davenport	15,000	1.90n	1	6	1:2:4
Fort Dodge	3,500	2.42	1	7	1:2¼:4
Keokuk	12,330	2.45	1	7	1:1½:3
Mason City	35,112	2.49	1	7 reinforced	1:2:3
Kansas:					
Fort Scott	650	2.85	..	..	1:2:4
Salina	0.50	2.75	1	6-8	1:2:4
Kentucky:					
Covington	5,400	3.00	1	..	1:2:3
Louisville	Alleys only	....	1	6	1:2:3
Maine:					
Rockland	2,307	3.25c	1	6	1:2:4
Massachusetts:					
Adams	7,000	2.24n	..	6½-8	1:2:4
Brockton	7,236	3.42	1	4 Hassam	1:2:4
Lowell	0.2949	....	1	4 Hassam	....
Lynn	9,466	2.25	1	8	1:1½:3
North Adams	10,843	2.54	1	6-8	1:2:3
Peabody	49,359	2.885	1	8	1:2:4
Watertown	21,534	2.52n	1	6	....
Michigan:					
Alma	6,000	2.24n	1	..	1:2:3
Minnesota:					
E. Grand Forks	43,000	....	1	7	1:2:3
Red Wing	31,632	3.28	1	7-8	1:2½:4
St. Cloud	500	2.45	1	7	1:2:3
Virginia	12,620	2.39n	1	6	1:2:3
Missouri:					
Bethany	7,600	2.35	1	6-8	1:2:4
Kansas City	53,777	2.62	..	7½	1:2:3¼
Sedalia	1,300	2.41	1	6 alleys	1:2:3
Nebraska:					
Fremont	1,900	2.43	1	6-7	1:2½:4
Lincoln	1,074	2.25	1	6	1:2:4
New Jersey:					
Bordentown	7,500	3.24	1	6-8	1:2:3
Camden	1,200	3.20	1	8	....
Collingwood	74,000	2.50	1	7	1:1½:3
Highland Park	5,000	3.00	1	7	1:2:3
Plainfield	2,313	13.75nf	1	6-8½	1:1¾:3
West Orange	4,500	....	1	7-11	1:2:4
New York:					
Binghamton	2,907	2.91	2	7	1:2:3
Geneva	500	5.00n	..	..	1:1½:3
Herkimer	6,726	2.70	1	6-8	1:1½:3
Little Falls	1,601	3.08n	1	6-8½	1:1½:3
Niagara Falls	1,838	4.35	1	8	1:2:3

TABLE NO. 5—CONCRETE PAVEMENT LAID DURING 1919 (Continued).

City and State.	Yards or miles laid.	Average cost per sq. yd.	Number of courses.	Thickness, inches.	Proportions of mixture.
Texas					
Dallas	20,455g	1.75	1	6	1:5½
Provo	34,258	2.25n	1	6	1.2 4
Washington					
Aberdeen	28,800	2.48n	1	7½	1:2:3
Auburn	25,000	2.32n	1	6	1:2:4
Bremerton	62,000	2.30n	1	7	1:2 3
Charleston	55,000	2.00	1	6	1:2.3
Wisconsin					
Appleton	638	3.15	1	8	1:2:3½
Baraboo	7,000	2.00n	1	8	1 2½:3
Beloit	9,130	1.99n	1	6-8	1:2:3
Delavan	23,350	2.33	1	6-8	1:2:3
Eau Claire	18,346	2.30	1	7	1:2:3
Edgerton	15,000	1.85n	1	6-8	1:2:3
Fond du Lac	360	2.60	2	6½	Top 1:1:1: Base 1.2½:5
Grand Rapids	25,000	1.525n	1	6-8	1:2.3½
Kenosha	3,161	2.35	2	8	....
Madison	14,970	2.09n	2	6-8	Base 1 2½:4 Top 1 1½:3
Racine	1,216	2.78	2	7	1:3:5
Waukesha	9,543	2.325	1	7	1:2:4
Clinton	18,000	2.25n	1	..	1:2:3½
Black Earth	13,000	2.25n	1	..	1:2:3½
Canada					
Charlotte, P.E.I.	10,000	1.50n	1	6	....

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[a] Including excavation $0.70 and base $0.07. [b] Contract let in 1917 at pre war prices involving loss to contractor. [c] Includes 1.160 linear feet concrete curb. [d] Simpson Bros. compressed concrete. [f] Cost per cubic yard. [g] Vibrolithic [n] Does not include grading or other work.

TABLE NO. 6—BITUMINOUS CONCRETE LAID IN CITY LIMITS DURING 1919.

City and State	Yards or miles laid	Average cost per sq. yd.	—Base— Kind	Thickness, inches	Cost
California					
Porterville	40,290	$2.75	1:3:6 concrete	5	....
Illinois					
Chicago Hgts.	3,000	2.80	concrete	6	....
East Moline	17,000	1.68nm	concrete	6	$1.18
Joliet	40,200	2.33n	concrete	5	....
LaGrange	40,000	1.59m	old macadam	..	....
Peoria	9,500	1.58nm	old brick	..	....
Indiana					
Fort Wayne	86,821	1.95n	1:2:4 concrete	..	....
Muncie	32,265	2.40m	old macadam	..	....
South Bend	7,056	1.59	tarvia	5	....
South Bend	26,351	2.572	concrete	..	....
Iowa					
Cedar Rapids	5,661	2.70n	....	4	....
Davenport	200,000	2.60n	concrete	5	....
Kansas					
El Dorado	50,000	2,625n	concrete	5	....
Salina	1.50	2.30	concrete	5	....
Massachusetts					
Brockton	18,872	2.30	stone	3	....
Michigan					
Lansing	7,814	2.40	concrete	6	....
Midland	8,634	2.645n	concrete	6	....
Minnesota					
E. Grand Forks	43,000	....	....	5	....
New Jersey					
Elizabeth	0.81	4.25	concrete	6	....
Jersey City	56,314	0.90n	old macadam	..	....
New Brunswick	3,404	2.70n	old macadam	..	....
New York					
Albany	4,531	2.78n	concrete	6	....
Elmira	5,093	3.25	1:2½:5 concrete	6	....

Ogdensburg ...	7,097	....	1	6-8	1:2:4
Oneida	16,980	3.26	1	8 1-3	1:1½:3
Schenectady ...	9,522	2.80	1	7	1:1½:3
Watertown	25,000	3.00	1	8	1:1½:3
North Carolina:					
Asheville	11,997	2.43	1	6	1:2:4
Wahpeton	8,832	2.87n	1	7	1:2:3
Ohio:					
Akron	0.50	....	1	7-9	1:2:3
Akron	0.48	....	2	7-9	1:1¼:2
Bucyrus	1,487	3.00	1	6-8	1:2:3
Columbus	1,916	....	1	7 average	1:2:3
Lakewood	8,375	3.60n	2	7	Base, 1:2½:4 sl'g Top,1:1½:2½gr
Newark	2,100	2.18	1	7	1:2:4
Toledo	38,958	2.36n	1	6-8	1:2:3 reinf'd
Pennsylvania:					
Franklin	18	2.70	1	6	1:2:3
Lebanon	8.28	2.84	1	6	1:1½:3
North East.....	1,262	3.09	1	6-8	1:1½:3
Pittsburgh	5,355	2.36n	..	..	1:2:3
Somerset	2,500	4.00n	1	7-10	1:2:3
South Dakota:					
Sioux Falls.....	6,400	2.80	..	..	1:2:4
Tennessee:					
Jackson	5,300	2.65	1	6	1:2:3

Fairport	4,926	1.85nm	concrete	5	....
Niagara Falls ..	2,356	4.66	concrete	6	....
Salamanca	2,325	4.25	stone	8	....
North Carolina					
Asheville	8,205	2.68	concrete	4	....
Ohio					
Akron	1.92	3.60	concrete	6	....
Perrysburg	16,171	2.40n	concrete	6	....
Oklahoma					
Oklahoma City.	22,770	2.35n	concrete	4	....
Pennsylvania					
Osborne	12,550	2.00mn	old macadam	..	....
Philadelphia ...	44,285	2.59	concrete	6	....
Rhode Island:					
Pawtucket	25,344	3.33	concrete	5	....
Pawtucket	2,612	3.33	concrete	5	....
Vermont:					
St. Albans	1,190m	1.25m	waterb'd mac.	6	....
Virginia:					
Covington	6,663	1.94	concrete	5	....
Washington:					
Aberdeen	10,560	1.88m	concrete	5	2.25
Wisconsin:					
Fond du Lac....	21,254	2.36	1:3:6 concrete	5	....
Racine	9,300	2.50	concrete	5	....

m Does not include base. n Does not include grading or other work.

TABLE NO. 7—RESURFACING PAVEMENTS.

City and State.	Kind of Pavement Resurfaced.	Years in Service Before Resurfac'g	Kind of Traffic Carried.	Material Used for New Surface.	Treatment of Old Pavement Before Resurfacing.	Cost of Resurfac'g per sq. yard.	Use Made of Old Material.
Alabama:							
Anniston	Bitulithic.	12	Business.	Asphalt seal coat.	Cleaned and painted with cut-back asphalt.	....	None removed, except holes cut for patches.
Selma	Brick.	10	Business.	Same bricks, turned over.	Conc. base repaired, brick relaid on sand-cement & grouted.	$1.00	Only a few bricks not used.
California:							
Alameda	Oil macadam	5 to 15	Residence.	98% asphaltic oil.	Scarified, leveled with new stone, rolled, oiled, screened and rolled.	$0.135	Used in the same job.
Connecticut:							
Manchester	Plain macadam.	....	Residence.	Hot refined tar, 1 gal. per sq. yd., and ¾" trap rock.	Patched with tarvia and ½" stone.	0.29	....
Middletown	Plain macadam.	....	Residence.	Tar penetration macadam.	Scari'd, shaped with grader.	1.15	All used in the job.
New Haven....	Plain macadam.	8 to 15	....	Sheet asph. and "National," 1½" binder and 1½" surface.	Scarified, shaped, crosswalks removed, depressions filled with No. 2 stone, sand-filled & rolled.	....	For fill only.
Putnam	Gravel.	....	....	Concrete.	....	....	Resurfacing other streets.
Illinois:							
Danville	2-course brick.	28	Heavy business.	Brick, asphalt filler.	Removed top course & sand cushion, spread min. of 3" of 1:6 conc., ¾" sand cush.	2.92	Patching existing pavements and filling.
East St. Louis..	Brick.	17	Through.	Asphalt, 1" binder, 2" surf.	Brick & cush. removed, new cement conc. on old base.	3.20	None.
Peoria	Brick.	24 to 30	Business.	Sheet asphalt, 1" binder, 1½ top.	Well swept, depressions filled with binder, light paint coat of asphalt.	1.75	None.
				Asphaltic conc.		1.58	....
Indiana:							
Bluffton	Sheet asphalt.	24	Thoroughfare.	Asphalt block.	Asphalt and 4" of old conc. base removed and 4" of new conc. laid.	3.28	None.
		22	Residence.	3" asphaltic macadam.	Asphalt removed, concrete scarified and 1" removed.	1.38	None.
Elkhart	Macadam.	10	Residence.	Sheet asphalt.	Crown reduced, leveled up with binder.	1.87	....
Fort Wayne....	Brick.	26	Heavy.	Shale brick.	Old brick and base entirely removed.	4.00	....
Marion	Macadam.	15 & 16	Both.	Stone.	....	1.40 per ton[a]	....
Muncie	Mac. & sheet asph	13	Business.	Asphalt.	Old sheet asphalt removed.	2.70	....
Peru	Bitulithic.	2	Residence.	Bitulithic.	Old surface removed.	1.80	Dumped.
Seymour	Gravel & earth.	10 to 20	Both.	Concrete.	Scarified and rolled thoro'ly	2.70	For shoulders and filling.
South Bend....	Tarvia macadam.	10	Residence.	Asphalt concrete.	Surface removed, base scraped and rolled.	1.59	....
Terre Haute....	Brick.	26	Business.	Brick.	Old brick removed, base leveled up.	2.74[b]	Sewer manholes, building found. and patching.

TABLE NO. 7—RESURFACING PAVEMENTS (Continued).

City and State.	Kind of Pavement Resurfaced.	Years in Service Before Resurfac'g	Kind of Traffic Carried.	Material Used for New Surface.	Treatment of Old Pavement Before Resurfacing.	Cost of Resurfac'g per sq. yard.	Use Made of Old Material
Iowa:							
Atlantic	Asphalt & conc.	Asph. 8, conc. 5	Both.	Tarvia & crushed stone.	....	....	....
Davenport	Brick.	25	Residence.	Asphalt concrete, 1½".	Rolled & swept, minimum of 1" binder.	1.88	....
Dubuque	Macadam & brick	Mac. 40, brick 20	Both.	Bitulithic.	Macadam brought to crown.	2.35	Used in the same job and repair other streets.
Fort Dodge....	Brick.	15	Both.	Wood block.	Cement cushion ½" to 1" on old concrete.	3.80	Filling
Iowa City......	Bitulithic.	8	Both.	"Bitustone."	Painted base with cement.	2.00 to 6.00	Old surface worn away
Waverly	Asphaltic conc.	6	Both.	Bitulithic.	Concrete added to base where necessary.	3.42	....
Kansas:							
Atchison	2-course brick.	30	Residence.	3" vertical fiber brick.	Top course removed, depression in bottom filled with concrete.	2.28	None
Kentucky:							
Covington	Brick.	16	Business.	Kentucky rock asphalt, 2"	Brick surface thoroughly cleaned.	2.90	None removed
Massachusetts:							
Brockton.......	Bitulithic.	15	Both.	"Willite," 2".	High points removed to give 2" depth.	1.85	....
Lee	Plain macadam	18	Business.	Tar macadam.	Scarified, old stone screened and new added, leveled and rolled.	1.20 1.00	Used in same job. ....
New Bedford...	Plain macadam,	....	Both.	Asbestos bit.	Cleaned holes filled with binder, painted.	....	Used for plain macadam, light travel.
	Bitulithic.	16	Both.			2.00	
Peabody	Plain macadam.	5 to 10	Both.	Concrete & granite block.	....	....	Best used to resurface light-traffic streets.
Springfield	Plain macadam.	15 to 25	Both.	Asphalt.	Scari'd & brought to grade.	1.25	For base on other streets.
Waltham	Macadam.	10	Both.	Bituminous macadam.	Scarified, new stone added, shaped, rolled.	.65	Side streets.
Watertown	Tar macadam	8	Both	Oiled and sanded.	Levelled and rolled.	....	....
Michigan:							
Alma	Concrete.	2	Business.	Tarvia A.	....	....	....
Midland	Macadam.	17	Both.	Sheet asphalt.	Binder used to get uniform surface.	1.79	None removed.
Missouri:							
Kansas City....	Brick	19 to 27	Business & both.	Sheet asphalt	Brought to surface by raising brick or filling with concrete and smearing with asph. concrete.	2.43	....
	Macadam.	10	Both.	Bituminous concrete.	Scarify & remove top 2½".	1.02	....
	Sheet asphalt.	12 to 25	Business & res.	Sheet asph., 1½" binder, 1½" surface.	Remove old asphalt, fill holes in base with concrete, or with binder if shallow.	....	....
Sedalia	Brick, asphalt, stone block.	25 & 28	1 business, 2 res.	Brick block, vert. fiber brick, asph. macadam.	Old surface removed, base thoroughly cleaned and brought to uniform surface with new concrete.	2.21	200,000 brick used for backing and rear walls in buildings.
Nebraska:							
Lincoln	2-course brick.	28, 27 & 28	Bus., res., both	Asphaltic concrete.	Top course removed, holes over 1" deep concreted; if shallower filled with top material.	1.09	Buildings and sewers.
New Jersey:							
Bound Brook...	Plain macadam.	19	Through business.	Tar macadam.	Scarified, small stones & dirt removed, rolled.	0.96	Resurfacing dirt streets.
Collingwood ...	Macadam.	11	Both.	Slag and asphalt.	Swept, patched.	....	Fill.
Garfield	Plain macadam	15	Both.	Asphalt macadam, 1"	Swept, scarified, repaired.	.58	Very little removed.
New Brunswick	Dollarway	6	Residence.	Tarvia A & screenings.	Concrete surface cleaned with brooms.	.45	....
Passaic	Asphalt macad.	6½	Both.	Asphalt & ⅝" trap.	....	.34	....
Plainfield	Plain macadam	16 & 20	Residence.	Tarvia X.	Scarified & shaped with new stone.	1.20	None removed.
Summit	Plain & asp. mac.	....	Residence.	Tarvia B & sand.	Swept clean.	.06¾	None.
Wallington	Plain macadam	20	Both.	Tarvia K P.	Holes cleaned and patched.	....	None.
Westfield	Macadam.	12	Residence.	Tar macadam.	Scarified.	.55	None.
West Orange...	Plain macadam.	20	Business.	Bitulithic & bitoslag.	Scarified if grade correct. Otherwise taken up, graded and relaid.	2.55 & 2.65	In adjoining streets for repairs.
New York:							
Binghamton ...	Brick.	16	Business.	Asphalt macadam.	Very carefully cleaned; flush-coated with hot oil.	.35	....
Brooklyn	Asphalt.	13 to 22	Both.	Asphalt.	Surface heated and ½" scraped off.	1.70	None.
Ellenville	Plain macadam	20	Both.	Bituminous macadam.	Cleaned, holes filled and rolled.	....	None.

TABLE NO. 7—RESURFACING PAVEMENTS (Continued).

City and State.	Kind of Pavement Resurfaced.	Years in Service Before Resurfac'g	Kind of Traffic Carried.	Material Used for New Surface.	Treatment of Old Pavement Before Resurfacing.	Cost of Resurfac'g per sq. yard.	Use Made of Old Material.
Geneva	Plain macadam	10	Residence.	Asphalt macadam.	Thoroughly cleaned.	1.30	....
Little Falls....	Macadam.	3 to 5	Business.	Oil mat.	Scarified.	....	....
Niagara Falls..	Asphalt.	14	Both.	Asphalt concrete.	Old surface removed.	....	....
Rochester	Macadam.	16	Residence.	Sheet asphalt, 2", binder 1"	Removed some material to get proper crown; filled large holes with 1:2½:5 concrete, small ones with binder.	Asph. 1.15 Binder 9.75 per ton.	None.
	Brick.	25	Residence.	Sheet asphalt, 2", binder			
	Medina stone.	30	Residence.	Sheet asphalt, 2", binder			
Schenectady ...	Brick.	20	Residence.	Asphalt.	Swept clean.	1.85	....
North Carolina:							
Fayetteville ...	Macad. & gravel.	3 to 8	Both.	1½" sheet asphalt on macadam, stone chips & bitumen on gravel.	Holes in macadam filled with binder & paint coat applied.	1.60	On old dirt streets.
Greensboro	Macadam.	15 to 20	Business.	Bitulithic.	Dirt removed, low places filled with binder.	1.55[d]	None.
Ohio:							
Akron	Creosoted wd. blk.	4	Business	Granite block.	Blocks failed completely. Base removed because stone blocks deeper.	....	Wood burnt, concrete to fill in dirt streets.
Columbus	Brick.	30	Residence.	Sheet asphalt.	Thoroughly cleaned, joints raked out, binder where needed.	2.40	None removed.
Lakewood	Brick.	20	Residence.	Bitulithic, 2".	Low places filled with bitulithic binder, new concrete where foundation was especially poor.	1.55[e]	None.
Oklahoma:							
Bartlesville ...	2-course brick.	8 and 12	Business.	Brick.	Foundation repaired with concrete where necessary	....	....
Pennsylvania:							
Altoona	Asp. block & brick.	Asph. 7, brick 15	Business.	Same as old.	....	....	Good ones saved for repair work.
Erie	Asp. on conc.	20	Both.	Sheet asphalt.	Low spots in foundation filled with bit. concrete.	2.15	None.
Freeland	Macadam.	5 to 8	Both.	Gravel and oil.	....	0.436	Repair work in alleys.
Greensburg	Shale block.	26	Business.	Shale block.	Old block, cushion and part of old foundation taken up, bed well rolled, new 5" concrete base put in dry, 1" of 1:3 dry cement mortar hand rolled, sprinkled after brick set.	2.81 for new blks 1.98 for old blks.	Half the old block relaid; balance used for fills.
Harrisburg ...	Sheet asphalt.	20	Both.	Sheet asphalt.	Asphalt removed.	1.50	....
Hazleton	Brick.	13	....	Amiesite.	Cleaned, depressions filled with concrete.	1.78	....
Media	Plain macadam.	4 or 5	Both.	Tar macadam.	Scarified.	....	Foundation course or filling.
Norristown	Plain macadam.	5 to 11. 15 to 30.	Residence Business	Seal coat & ¼" slag.	Scarified deep, dirt removed, slag spread and rolled, good stone forked, spread and rolled.	.70	
Osberne	Macadam.	10.	Both.	Asphaltic concrete.	Scarified and graded.	2.35[f]	....
Pittsburgh ...	Irregular blkstone	15.	Residence.	Brick.	6" concrete in place of old gravel base.	3.83	Broken stone for curb drain.
Reading	Brick	15.	Both.	Sheet asphalt.	....	1.95	Old brick for gutters and crossings.
Shippensburg ..	Macadam.	50.	Both.	Macadam.	Scarified 6" deep.	....	On side streets.
Tyrone	Plain macadam.	....	Residence.	Screenings and oil.	Holes swept clean.	....	None removed.
Tennessee:							
Clarksville	Plain macadam.	18	Business.	Bituminous macadam.	Scarified, graded & rolled.	.37	....
Texas:							
Dallas	Bitulithic.	10	Semi-business.	Bitulithic.	Roadway widened from 30' to 44'; new foundation at sides, new 2" surface on top of old.	1.50	....
	Wood block.	7	Residence.	2" bitulithic on 2" binder.	Wood blocks removed. New pavement on old base.	2.25	....
Houston	Creosoted wd blk.	8	Business.	2" bitulithic on 2" binder.	Base patched where necessary.	2.75	Blocks too badly broken for use.
Longview	Plain macadam.	6	Both.	Asphalt surface coat.	Scarify, add new rock and screenings.	.35	None removed.
San Antonio ...	Cre. wood blk.	3 to 4	Business.	Creosoted wood block.	Old blocks removed, some relaid.	2.15 & 4.20	....

TABLE NO. 7—RESURFACING PAVEMENTS (Continued).

City and State.	Kind of Pavement Resurfaced.	Years in Service Before Resurfac'g	Kind of Traffic Carried.	Material Used for New Surface.	Treatment of Old Pavement Before Resurfacing.	Cost of Resurfac'g per sq. yard.	Use Made of Old Material.
Vermont:							
Middlebury	Gravel & pl. mac.	....	....	Same material.	....	.80	....
St. Albans	Plain macadam.	7	Both.	Tar concrete.	Depressions brought up to grade.	....	....
Virginia:							
Danville	Bitulithic.	9g	Residence.	Asphalt.	....	....	....
Wisconsin:							
Fond du Lac	Brick, sand filler.	21	Both.	Old brick relaid.	Filled depressions in base with concrete; cushion of 1:5 dry mortar.	1.48h	Bricks scraped clean, washed with hose, laid upside down.
Lake Geneva	Gravel.	8	Heavy through.	Gravel.	Scarified and rolled.	....	None removed.
Marinette	Macadam.	22	Residence.	Macadam.	....	....	....
Waukesha	Tar macadam	10	Both.	Gravel and asphalt,	Swept clean.	.20	None removed.

a—for stone; work done by city street gang. b—plus about 50 cts. per sq. yd. for stone for base. c—holes cleaned, loose stone removed, sides cut vertical, filled with broken stone from 2½" to 1", tamped solid, painted with a coat of Tarvia KP, ¼ to ½ gal. per cu. yd. On this was placed a mixture of 1 part sand, 3 parts ¾" stone, and 16 gal. of Tarvia KP to fill the hole; tamped with heavy iron tamper till level with pavement; seal coat of Tarvia KP covered with screenings. d—$1.40 for bitulithic, 15 cts. for preparation of base. e—Also $10 per ton for binder. f—$2 for surface, 35 cts. for preparing base. g—Resurfaced four times since 1910. h—Average for 4,670 sq. yds., including 11,000 new brick.

TABLE NO. 8—TAR OR ASPHALT MACADAM LAID IN CITY STREETS DURING 1919.

City and State.	Yards or miles laid.	Av. cost, sq. yd.	Thickness, inches,	Gallons, per sq. yd.
California:				
Alameda	1,000	$2.86	6	1½
Connecticut:				
Manchester	5,185	1.32n	..	2½
Middletown	9.126	1.30	3	3
Illinois:				
Danville	17,000	1.98n	1	2
Indiana:				
Bluffton	5,172	1.38	3	1 per inch
Iowa:				
Dubuque	1,800	1.35n	..	1¾-2
Kansas:				
Salina	0.12	1.57	..	2¼-2 1-5
Kentucky:				
Covington	1,000	2.50n	10	2½
Maine:				
Auburn	0.500	1.30n	6	2½
Massachusetts:				
Arlington	4,100	3.00	6	2¾
Brockton	20,236	1.90	4	2¼
Lowell	0.2753	...	3 or 4	1½
Lynn	54,632	1.40	3 and 4	2¼
New Bedford	21,274	1.80	6	..
Peabody	3,861	1.25	3	2¼
Springfield	27,000 tar	1.30	2	1½
Springfield	10,000 asph.	1.40	2	1½
Waltham	15,800	0.65	4	2½
Minnesota:				
Faribault	10,850	0.30n	..	..
Missouri:				
Kansas City	3,530	1.73	..	2-2½
Sedalia	680	1.15n	2½	2
New Jersey:				
Bound Brook	1.5	0.96	4	1.83
Garfield	3,780	1.15	7	2½
Summit	1.730	0.80	3	2 Tarvia X
Westfield	6,700	1.68	4-6-7	½ to ¾
West Orange	28,000	1.90	7	3
New York:				
Binghamton	24,525	...	6 base 2 top	2
Elmira	1,859	...	3	2½
Geneva	7,500	1.30n	..	2¼
Poughkeepsie	0.56	2.61	7	3
Rochester	6,100	2.10n	8	2¼
Ohio:				
Akron	0.85	...	..	..
Columbus	6,000	...	..	2½
Pennsylvania:				
Norristown	18,500	0.70	6-8	2¼
Philadelphia	4,815	2.87	8	2-2½
Rhode Island:				
Pawtucket	27,700a	...	..	...
Texas:				
Gainesville	50,000	1.23n	6	0.6
Wisconsin:				
Waukesha	14,777	2.145	8½	2½

a—Partly temporary work to last a year or two until permanent work has been planned. n—Does not include grading or other work.

TABLE NO. 9—GRAVEL PAVEMENT LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cost per sq. yd.	Thickness, inches
Alabama			
Selma	0.50	....	..
Connecticut			
Putnam	1,000	$0.40	7
Indiana			
Greenfield	3.0	2.50 cu. yd.	6
Lafayette	12,300	1.05	8-12
Peru	1.0	0.30	..
Louisiana			
Kentwood	2.0	0.284	6
Maine			
Auburn	0.75a	....	4
Massachusetts			
Lowell	3.23	....	6
Waltham	50,000b	0.18	4
Watertown	1.50c	1.35	6-8
Minnesota			
Faribault	5	....	6
Montevideo	9	....	8
New Jersey			
Atlantic City	13,230c	0.74	6
Millville	1.0	....	6
New York			
Herkimer	4,210	0.80	5
Ohio			
Sciotoville	1,500	1.00	8
Pennsylvania			
East Bangor	5,000d	0.30	8

a—Surface 4-inch rolled on 8-inch stone base; cost, $12,000 per mile. b—Rolled and oiled. c—Rolled. d—Resurfaced. n—Does not include grading or other work.

TABLE NO. 10—BITULITHIC PAVEMENT LAID IN CITY STREETS DURING 1919.

City or State.	Yards or ml. laid.	Aver. cost per yard.	Base Kind.	Base Thickness Inches.
Iowa:				
Albia	26,000	3.84	Concrete.	5 to 7
Centerville	47,000	3.77	Concrete.	5 to 7
Dubuque	56,500	2.99n 2.35n	Concrete. Macadam.	.. ..
Reinbeck	38,000	3.22	Concrete.	4
Fort Dodge	10,000	3.42	Concrete.	5
Tama	57,000	3.23	Concrete.	5
Waverly	22,000	3.42n	Concrete.	5
Massachusetts:				
New Bedford	62,274	2.00m	Crushed stone.	6
Minnesota:				
Fairmont	30.278	3.33n†	1:3:5 concrete	6
St. Cloud	43,296	2.74	Concrete.	5
Virginia	10,734	3.63n	Concrete.	6
Montana:				
Billings	74,982	2.48n	Concrete.	5
New Jersey:				
West Orange	25,000*	2.55	Old macadam.	5
West Orange	700	3.42	Broken stone.	
New York:				
Rome	27,000	3.05	Concrete.	4
North Carolina:				
Greensboro	44,200	1.40m	Concrete.	4
North Dakota:				
Wahpeton	31,931	3.15n	Concrete.	5
Ohio:				
Lakewood	27,158	1.65nm 2.12nm	Concrete.	6 8
Pennsylvania:				
Lebanon	10,900	3.60	Concrete.	5
Texas:				
Dallas	58.904	2.60	......	5
Houston	12,715	3.12mn	Rein. concrete.	
Houston	4.098	2.25mn	Old concrete.	5
Utah:				
Ogden	38,946	2.25n	Concrete.	6

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†Including grading and drainage and exclusive of curb and gutter, $4.33. *Resurfacing, 2-inch. m Does not include base. n Does not include grading or other work.

TABLE NO. 11—MACADAM LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cast per sq. yd.	Thickness Inches.
Connecticut:			
Manchester	14,759	$0.47[n]	5
Putnam	1,000	0.80[n]	7
Iowa:			
Dubuque	[t]2,622	0.90[n]	....
Massachusetts:			
New Bedford	4,740	0.72	6
Peabody	3,300	0.55	4
Springfield	3,000	1.01	6
Waltham	[s]20,000	0.40	4
Minnesota:			
Virginia	[a]3	....	....
New Jersey:			
Garfield	[b]23,380	0.58	....
Summit	10,560	0.75	3-4 new
Wallington	[c]66	12.50	....
New York:			
Ogdensburg	25,000	....	3-5 resurfacing
Sidney	1.00	3.00	....
Watertown	20,00	1.00	6
Pennsylvania:			
Shippensburg	6,000	....	8
Wisconsin:			
Lake Geneva	[d]2,400	0.50	5
Manitowoc	15,000	1.10	6
Marinette	[e]20,120	0.30	4
Portage	3,009	1.20	....

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[a] Scarified and treated with Tarvia B.
[b] Repaired and resurfaced.
[c] Repaired and patched with Tarvia K.P.
[d] Gravel mixed with stone crushed ni city's plant.
[e] Repairs on old macadam.
[n] Does not include grading or other work.
[s] Sealed on surface with asphalt and chips.
[t] Telford base used.

TABLE NO. 12—LABOR AND CONTRACTING.

City and State	Increase in Cost, percentage	Common labor Available	Common labor Prevailing price in 1919 Per hour or day	Common labor Prevailing price in 1919 Hours per day	Kinds of pavement laid by day labor	Kinds of pavement laid by contract
Alabama.						
Anniston	.....	100-500	$2.50-$3.00	10	none	....
Selma	20	50	2.00	9	none	all
Troy	87	....	....	..	....	....
Arkansas.						
Fort Smith	35-50	....	3.00-3.50	8 & 10	....	....
California.						
Alameda	.....	....	4.00	8	none	....
Orange	10-25	....	3.50-4.00	8	....	....
Pomona	50	sufficient	....	..	....	....
Portersville	50	sufficient	4.00	8	none	all
Colorado.						
Boulder	80	200	3.25a	8	none	all
Longmont	50	variable	4.00	8 or 9	none	all
Connecticut.						
Bristol	.....	....	4.50	9	....	....
Manchester	60	50	4.14	9	plain macadam	tar macadam
Middletown	.....	....	3.50-5.00	8-10	all	none
New Haven	15-50	....	4.50	9	none	all
Putnam	100	....	0.50	9	gravel & macadam	concrete
Florida.						
Tampa	40	....	3.00	9	none	all
Georgia.						
Dublin	50-80	100	2.50	10	none	all
Elberton	.....	very few	0.30	..	....	....
Griffin and Madison	38-60	....	0.40	..	none	all
Waycross	.....	100	3.00	10	....	....
Illinois.						
Alton	75	....	3.20	8	none	all
Canton	.....	100	4.00	8	....	....
Chicago Heights	45	200-300	57½	9	none	all
Carlinville	90	150	4.80	8	none	all
Collinsville	.....	150	0.50	8	none	....
Danville	75	....	0.45	9	none	all
DeKalb	.....	....	0.60	9	....	....
East Moline	40	....	4.00	9	none	all
East St. Louis	.....	....	4.00-5.40	8	tarvia patch	asphalt, brick and concrete
Fulton and Morrison	.....	20	0.50	8-9	....	....
Gillespie	63	50	4.00	8	none	all
Joliet	12	....	0.70	..	none	all
La Grange	25	....	5.60	8	none	all
Murphysboro	60	....	4.00	8	none	all
Naperville	40	....	4.50-5.40	9	none	all
Peoria	50-60	....	0.40	9	none	all
Urbana	75	....	4.50	9	none	all
Waukegan	10 (brick)	80	5.60	8	none	all
Wheaton	40 (labor)	none	0.70	10	....	....
Indiana.						
Bluffton	50-75	60-75	5.00	10	none	all
Crawfordsville	96	250	4.00	10	none	all
Crown Point	.....	10-25	4.00	8	....	....
Elkhart	20	50	4.00	10	none	all

TABLE NO. 12—LABOR AND CONTRACTING (Continued).

City and State	Increase in Cost, percentage	Common labor			Kinds of pavement laid by day labor	Kinds of pavement laid by contract
		Available	Prevailing per hour or day	Price in 1919 hours per day		
Fort Wayne	30-100	very few	6.50	10	none	all
Greenfield	.....	scarce	4.00	10	gravel	....
Greenwood	85	60	4.00	10	none	all
Kendallville	....	....	5.00	10	....	....
Lafayette	43	200	4.00	9	none	all
Marion	....	....	.45	10	....	....
Muncie	80-100	none	4.00	8	none	all
Noblesville	20	25-30	....	..	none	.all
Peru	....	100	3.50	10	none	all
Portland	....	25	3.50	10	none	all
Seymour	100	200	3.50-4.50	10	none	all
South Bend	86.7	fair supply	5.95	9	none	all
Terre Haute	50	....	3.20	8	none	all
W. Lafayette	60	....	.35	..	....	....
Iowa						
Atlantic	100	very few	5.00	10	none	all
Boone	....	scarce	4.00	8	....	....
Cedar Rapids	....	....	.50	9	none	all
Centerville, Albia and Mystic	100-150b	....	.45	..	none	all
Council Grove	....	....	4.00	8	none	all
Clinton	100	75-100	4.00	8	....	....
Creston	100	....	4.00-5.00	10	none	all
Davenport	40-50	....	4.00	10	none	all
Denison	....	....	3.00	10	none	....
Dubuque	50c	....	5.00	10	none	all
Emmetsburg	....	50	4.50-5.00	10	none	all
Estherville	....	50	6.00	10	none	all
Fort Dodge	100-125	....	.50-.75	..	none	all
Iowa City	100	1,500	3.60	9	none	all
Jefferson	....	....	5.00	10	none	all
Keokuk	100	....	4.50	10	none	all
Le Mars	....	50	4.50-6.00	10	none	all
Mason City	....	....	5.50	10	none	all
New Hampton	....	very few	4.00	10	none	all
Tama	60	20	5.50	10	none	all
Waverly	39	50	4.00-5.00	10	none	all
Kansas						
Atchison	80	....	3.00-4.00	8	none	all
Chanute	125	100	3.50	8	none	all
El Dorado	95	....	4.00	8	none	all
Fort Scott	150	none	.50	8	none	all
Manhattan	138	....	4.00-5.00	8	none	all
McPherson	....	....	4.00	8	none	all
Osawatomie	....	very few	4.00	8	none	all
Salina	75	150	4.00	8	none	all
Winfield	100	....	.40	8	none	all
Kentucky						
Covington	60	250	3.50	8	none	all
Frankfort	....	40-50	3.00	9	none	all
Louisville	100	....	3.50	10	none	all
Louisiana						
Kentwood	25	50	2.75	10	none	all
New Orleans	....	....	4.45	9	none	all
Maine						
Auburn	....	....	4.05	9	gravel	brick & macadam
Rockland	30	....	3.50	9	none	all
South Paris	....	....	3.00	9	.none	all
Maryland						
Easton	....	200	3.25	9	none	all
Massachusetts						
Adams	80	50	3.25	8	none	all
Arlington	....	100	4.00	8	none	all
Brockton	50-75	....	4.00	8	granite block & bit. macadam	sheet asphalt, bit. concrete & concrete
Lee	....	very few	3.20	8	none	all
Lowell	....	....	4.00	8	none	all
Lynn	....	....	4.36	8	all	none
New Bedford	90	none	4.40	8	plain & bit. macadam	bitulithic & granite block
North Adams	90	scarce	3.50	8	....	....
Peabody	65	200	5.85	9	....	....
Springfield	30	....	4.00	8	all	none
Waltham	35	none	4.00	8	all	none
Watertown	30	....	4.50-5.00	8	gravel	concrete & granite block
Michigan						
Alma	....	scarce	5.00	10	none	none
Flint	33⅓	....	5.00	10	all	all
Ionia	80d	....	4.50	10	none	none
Lansing	90	....	5.40	9	sheet asphalt	....
Midland	....	....	3.00	9	none	all
Minnesota						
Albert Lea	....	200	5.00	10	....	....
Brainerd	....	100	4.00	8	....	....
E. Grand Forks	....	....	.50	..	....	....
Fairmont	53	50	5.00	10	none	all
Faribault	50	....	5.00	10	all	none
Hibbing	....	....	4.50	8	....	....
Montevideo	....	....	4.00	8	....	....
Red Wing	118	25	3.60	9	none	all
St. Cloud	15	....	4.50-5.00	10	none	all
Virginia	....	....	5.00	8	none	all
Willmar	....	....	.50	..	....	....

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a—City rate; others, $3.50. b—Bitulithic, 100; brick, 150. c—On brick and bitulithic; none on macadam. d—Compared with 1912; 68% more than 1916, 35% more than 1917. e—Bituminous macadam, 53; concrete and brick, 140; asphalt, 102; granite block, 153. f—Asphalt, 50; brick, 80. g—$3.00 municipal for 8 hours, $4.75 private for 9 hours. h—Brick, 28; concrete, 43. i—Granite, 52; sheet asphalt, 128. k—Bitulithic, 44; brick, 57. l—Water-bound macadam, 80; concrete, 100. m—Brick, 75; concrete, 125. n—Concrete, 23; asphalt, 30.

PUBLIC WORKS.

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A. PRESCOTT FOLWELL, *Editor*
FRANK W. SKINNER, *Associate Editor*

Publisher's Announcement

"Municipal Journal & Public Works," a weekly, and "Contracting," a semi-monthly publication devoted to construction, have been merged into one paper under the title of PUBLIC WORKS, and this is the first number of the combined papers.

PUBLIC WORKS will be issued weekly and, as the comprehensive name indicates, it will be devoted to public works—their design, construction, and maintenance—and to advance contract news relating to its field. The best features of both papers will be retained and no subject heretofore covered will be neglected.

With the editors of both publications concentrating their efforts upon one, those interested in public works will have at their command a better and more useful paper than either was when published separately.

It is the firm determination of the publishers and editors to make this paper indispensable to those who desire to keep abreast of the times so far as public works are concerned.

The outstanding feature of a class paper should be the dependability of the information published. If the statements that appear in its pages are not authoritative and of practical value, they are worse than useless. A busy man has no time to waste in reading articles dealing with impractical theories and schemes, or diffuse descriptions of unimportant details. He wants real information, concisely given, which will help him to do the work he has undertaken, better and more economically.

That is the kind of service Public Works will give, and upon that it bases its plea for the support of those interested in its field.

What of the Old Pavements?

The greatest problem of the street department, bureau of highways, or whatever the name, in every well-paved city (and will any today admit that it is not in this class?) is the keeping of its pavements in good condition. Money invested in pavements gives returns in the form of facilitating vehicular traffic, and this return diminishes as the square or some higher power of the number and depth of holes and other irregularities that grow in its surface with use.

Use is bound to bring deterioration and necessitate repairs, no matter what the kind of pavement; and the investment made by a community in a pavement becomes less gilt-edged as these repairs are neglected. Repairing is in many cases more difficult, both to plan and to perform, than is new construction. We believe, therefore, that we could present nothing in these pages that would be of more value to paving officials and contractors than articles dealing with this subject. A general review of the subject is given in the leading article this week, and we purpose to publish, during the next few weeks, a series of articles describing methods employed in different cities and for the various kinds of pavements. Any who can contribute to this information from their own experiences by sending descriptions of them to this journal for publication, will confer a benefit upon paving men generally, and we will welcome all such communications.

Water Works Pumping

The use of electric motors and internal combustion engines for operating water works pumps is of comparatively recent date, but a considerable number of such pumping plants now operate by these newer motive powers, and the number is continually increasing. There can be no question, however, that under some conditions steam power remains the more desirable. There is the danger that many, learning of the satisfactoriness of one or another of these types at other places, may unquestioningly conclude that it would be best for their own also; which does not necessarily follow.

In order that those having this matter under consideration may benefit by the experiences of others and learn the conditions under which each type has proved most satisfactory, we are intending to publish a series of articles giving such information, furnished by the superintendents of a number of plants where two or more types of plant are being or have been used. The first of these articles will be found in this issue, beginning on page 70.

Creditable Subaqueous Tunneling Under Difficulties

The restriction of delay until the completion of the work that is sometimes enforced for engineering construction fortunately does not apply to the interesting operations of the 14th street subway tunnels, New York. Although this work is still in an incomplete condition, the critical stages have been passed and as all of the excavation methods have been thoroughly worked out and those operations practically finished, we are able to review them and in this issue describe the principal features of the subaqueous tunnelling that ranks among the most advanced and important examples of its type.

The work was prosecutted successfully under very difficult conditions, namely, driving a large heading through very soft, wet material; and partly through such material and partly through overlying rock at the same point. It was necessary to work under heavy pneumatic pressure to expel ground water from the heading, and for a considerable distance the bed of the river was not adequate to resist the upward pressure and was reinforced by a temporary clay blanket.

The work was inevitably dangerous but was so well protected by the most complete improved safeguards that, although a very large number of "sand hogs," notoriously impatient of restrictions, were employed in very short shifts, all casualties due to the dangerous conditions were avoided. The satisfactory execution of the work, despite added war-time handicaps, is a notable achievement reflecting much credit on the officials, engineers and contractors responsible for it.

Interesting Contractors in Highway Work

A notice has been sent to road contractors in Montana by John N. Edy, chief engineer of the State Highway Commission of Montana, suggesting that a meeting of contractors be held in Helena "to afford an opportunity for contractors to familiarizing themselves with the program of construction proposed for 1920, and with the requirements of the specifications under which such improvements will be built." The recipients of the notice are requested to answer on an enclosed post card stating whether or not they will attend such a meeting if held before March 1st. If a sufficient number of favorable replies are received, such a meeting will be arranged for.

This seems like an excellent idea for interesting contractors in state highway work, and one worth considering by the highway departments of other states. It might be used, also, as an opportunity for receiving from the contractors suggestions for making changes in the specifications and contract which would make them more acceptable to the contractors without lessening their effectiveness in securing good work.

Since the above was written we have received a circular, dated January 29th, issued by C. C. Cottrell, state highway engineer of Nevada, inviting "contractors and prospective bidders on state highway work" to a meeting at Reno, on February 13th, in order that they may obtain a thorough understanding of everything pertaining to the construction of the state highways, "including the submission of bids, furnishing of bonds, inspection, interpretation of plans and specifications, progress payments and completion of work." Suggestions are asked from those who are now doing work for the state or who are about to bid upon it.

Such invitations as this may well be important steps towards that mutual understanding and co-operation between contractors and engineers which we have from time to time urged as important for the best interests of all parties concerned, including the tax payers.

Electric and Steam Power for Pumping Plants

This is the first of a series of articles in which managers and superintendents of water works plants will give facts and figures drawn from their experiences in operating both electric or internal combustion pumping units and steam pumping units in the same plant, illustrating the conditions under which each is the more satisfactory. In this instalment the plants at Elmira, N. Y., Dover, N. H., and Hagerstown, Md., are described.

During the past few years an increasing number of water works pumping plants have adopted electricity as a power, either supplanting or supplementing steam plants used previously. Information collected by this Journal about two years ago showed that at that time about twenty per cent of the eight hundred plants reporting had both electric and steam pumping machinery either in active service or in reserve.

The relative desirableness of the two types of plant depends upon first cost, cost of operation and upkeep, size of building required, reliability of operation, convenience of operation, and perhaps other considerations. The conditions as to each of these will vary in different cities, and the wisest decision in one case need not necessarily be the best in another.

Believing that a great many water works departments and companies are interested in the relative economy and general desirableness of these two types of plants, we have arranged to secure narratives of the experiences of a considerable number of superintendents and managers of water works plants where both kinds of machinery are installed. Our aim is to secure in each case such complete data and descriptions of the local conditions as will enable others to apply the facts, figures and conclusions to their own plants. One such article was given in the issue of Municipal Journal for March 1st, 1919—a description of the changing of the plant at Lancaster, Pa., from a steam plant to an electrical one, giving at considerable length the figures that formed the basis of the decision to make the change, and those taken later which justified that decision. We expect to publish a series of such statements at short intervals during the next few weeks or months, and present the first instalment herewith.

Elmira, N. Y.

Information concerning the Elmira, N. Y., municipal plant has been furnished by H. M. Beardsley, the general manager for the Water Board. Mr. Beardsley's statement is as follows:

The first operation of a pumping unit by electricity in our pumping station came about while the plant was privately owned and was for the purpose of aiding the electric department rather than the water department. The Elmira Water, Light & Railroad Co. owned and operated the water works plant, the gas plant, the electric power plant and the street railroad system of this city. The water department was doing better financially than any of the other departments and when the development of electric energy for power purposes began, some ten years ago, it was seen that the load on the power lines of our pump station, which could be controlled by the power plant and not operated on peak load hours, would benefit the electric station immensely by filling in the valleys in the night load and mid-day load. The use of water at that time was about five and a half million gallons per day. A seven and a half million gallon motor-driven pump was purchased and installed and power was furnished by the electric department to the water department at station cost. The pump was a 2,300 volt pump, which was the station voltage, and no additions were made to the station cost for distribution, maintenance or general overhead expense. By this means the cost was reduced enough so as not to militate very greatly against the water works operation.

The plant being privately owned, the engineers and firemen could work twelve hours per day. Under electric operation the work was not heavy and two men, each working twelve hours, could handle the pump station. Even so, the pumping costs were a little higher under electric operation than under steam operation.

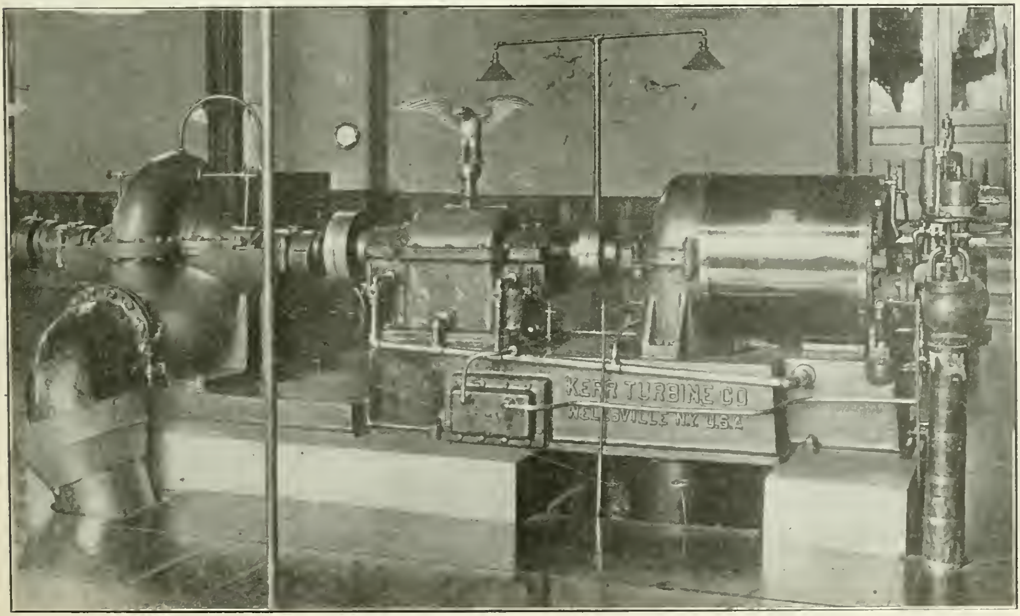
MUNICIPAL OPERATION.

On May 1st, 1915, the plant became a municipal plant through purchase by the city of Elmira, and the question of costs of power came to the front immediately. The plant was equipped with a ten-million-gallon Worthington steam pump installed in 1899 and a two-stage Worthington electrically-driven pump installed about 1908.

Just here let me say that we have two sources of supply. We have a four mile square water-shed, the water from which is impounded in a hundred-million-gallon reservoir, which furnishes us from 35 to 50 per cent of our entire supply by gravity to our filtration plant. Whatever is needed besides this is pumped from the Chemung river by the above-mentioned pumping plant, through about 9,000 feet of 24-inch pipe, against a total head, including suction and friction, of about 150 feet. This dual supply prevents long continued runs on our pumping plant because whenever the storage supply is sufficient its use is always given preference, because of both the quality of the water and the saving in operating costs.

To go back again to the question of operation. For the first few months after the purchase of the plant, the pump station continued to be operated electrically, following the practise by the private company, because we had made a very satisfactory contract with the private company which permitted, among other things, the use of current from 9 p. m. to 6 a. m. at one cent per kilowatt hour.

For the month of June, 1915, we used a little water from the storage reservoir but pumped 138,420,000 gallons, using 115,850 kilowatts or .837 kilowatt per thousand gallons. Total cost including labor was 1.15c per thousand gallons. During July and August we used from the storage reservoir. In September we pumped 116,610,000 gallons using 93,730 kilowatts or .804 kilowatt per thousand gallons and the total cost was 1.06c per thousand gallons. In November it was determined to use the steam unit, as it was estimated that the cost of pumping would be much less. Coal was then costing us $2.30 per net ton, plus 40c per ton for hauling and delivery. In November, 1915, 156 tons of coal were used to pump 112,130,000 gallons. Total cost of pumping, including labor, was .77c per thousand gallons. In December coal was 15c a ton higher and we use 151 tons to pump 104,720,000 gallons. Total pumping cost, including labor, .87c per thousand gallons.



New Steam Unit at Elmira, N. Y., Water Works Pumping Plant.

The labor crew was three engineers and three firemen working in three shifts of eight hours each, as required by state law for municipal plants. Fifteen to eighteen hours of pumping were necessary every day to keep up the supply.

THE NEW PLANT.

During 1916-1917, both pumping units named above, having outlived their usefulness, a new steam unit and a new electric unit were installed. No change was made in our boilers, as we have two Edgemoor water tube boilers of 250-horse-power capacity, each, either one of which could furnish ample steam for our purposes.

We installed a 260-horse-power Kerr multi-pressure-stage, horizontal steam turbine operating at a normal speed of 5,000 r.p.m. This was connected through a flexible coupling to a set of herringbone reducing gears for reducing the speed to the required pump speed. The pump was a seven and a half million gallon Allis-Chalmers centrifugal pump. The condenser was a C. H. Wheeler waterworks type.

For the electric unit we installed an Allis-Chalmers 12-inch double suction, single stage, horizontal shaft centrifugal pump, direct connected to one300-horse-power, 1.170 r.p.m., 2,200-volt, 60-cycle three-phase induction motor.

The costs of these two units, including all expenses of installation, inspection and tests, were $8,466.69 for the steam unit and $3,124.83 for the electric unit.

RELATIVE COSTS OF OPERATION.

Water was so plentiful in our storage reservoir that it was not necessary, until February, 1918, for anything more than trial tests to be run with the steam unit. In that month we used 90 tons of coal to pump 83,110,000 gallons of water; total cost of pumping, including labor, being 1.03c per thousand gallons. Coal at that time was costing $4.42 per net ton, including hauling. Labor rates then having a considerable advance and coal becoming scarce and higher priced, we found that steam cost was going considerably higher than would be the cost for electrical operation under our contract, which was still in force. During March and April of that year storage water was used almost entirely. In May, 82,670 kilowatts were used to pump 124,000,000 gallons. This, it will be noted, was with the new pumping unit and was .657 kilowatt per thousand gallons as against over .80 kilowatt with the old unit. The total cost for that month, including labor, was 1.02c per thousand gallons. We had then, of course, discharged our three firemen and the labor cost included only three engineers, working eight hours each.

That the electric unit has continued to function with the same efficiency is shown by the figures for December, 1919, the last month for which figures are available. During that month 74,050 kilowatts were used for pumping 112,400,000 gallons, or .66 kilowatt per thousand gallons. On account of the advance in labor, however, three men now cost the same as six men did in 1915. The total cost of pumping was 1.18c per thousand gallons.

These figures give a very good comparison of our pumping costs by the different operations. It will be noted that in actual operation steam cost is much less than electrical cost, even though we have a night rate of one cent per kilowatt hour.

Other costs, of course, must be included; but in the case of an old enterprise already possessing lands and buildings which carry a certain fixed over-head, I cannot see that such values should enter into the decision as between an electric and steam unit. If a brand new plant were being erected, of course, many such items should be taken into consideration. As a matter of fact, however, the steam turbine has cut down the required floor space so nearly to that of the electric unit that the extra room needed for steam apparatus as against electric apparatus is just the room necessary for the boilers and for storage of coal.

As regards reliability of operation, we have no fault to find with either. Our experiences with both have been eminently satisfactory.

While our experience with actual cost of operation is so much in favor of steam, yet we feel that electricity must have credited to it some things which warrant us in paying a little more for electric current than our steam operation cost. The chief factor is the flexibility of operation. We get so much water from storage that there are times, of course, when we do not need any pumping station at all. If we were operating with steam, which would require six men on our pay-roll all the time, there would be about 150 days a year when there would be practically nothing for the men to do. If, on the other hand, we had to operate our pump station continuously or (if not continuously for the twenty-four hours) if we had to operate it several hours *every* day, we should undoubtedly operate with steam as a matter of saving in expense.

Dover, N. H.

The facts and figures for the Dover, N .H., municipal plant have been furnished by Henry E. Perry, the superintendent. He states that the pumping station is of brick 30 x 36 feet in dimension, with a boiler room of the same size and a frame coal shed 25 x 45 feet. The steam pumping plant was erected in 1888 at a cost of $10,640, the building having cost $7,300. The steam pumping outfit consists of one George F. Blake compound duplex pumping engine with a capacity of 2,000,000 gallons in twenty-four hours, with jet condenser, boiler, etc.

In 1913 the city put in a 2,500,000 gallon De Laval centrifugal two-stage pump, direct connected to a General Electric 550-volt, 3-phase, 60-cycle, 1,750 r.p.m., squirrel-cage induction motor with standard compensator, transformer, etc., the whole costing $2,500.

The steam unit occupies the boiler room referred to and a space of 15 x 36 feet in the pump room. The electric pump and the motor occupy a space of about 10 x 15 feet in one corner of the pump room. There is still space in the pump room for three more electric units of the same type.

Figures for cost of operation show that to pump 1,000,000 gallons cost $28.54 with the steam unit and $25.90 with electricity. Water is pumped through 2,690 feet of 16-inch pipe to a reservoir against a dynamic head of 185 feet.

Reliability of Operation—we have been very fortunate as to stoppages of either steam or electric unit on account of mechanical troubles, coal shortage, strikes, lightning, or other causes. Neither plant has been stopped for more than three days altogether since the plants were installed.

Convenience—The electric outfit has to us one great advantage over steam, in that, immediately upon throwing on the switch, the pressure rises, while with steam it takes about one hour at starting to get normal pressure and nearly that length of time to work the steam down at stopping. In addition, the electric unit has caused no trouble or annoyance to neighbors from noise or smoke, as is the case with steam.

Our purpose in installing the electric unit was that we might have two kinds of power so that, in case of the failure of one, we would have the other available. We have found these two to make an ideal combination.

Hagerstown, Md.

The manager of the municipal water works of Hagerstown, Md., Albert Heard, gives the following description of the plant in that city:

The Water Department of this city receives the bulk of its water supply by gravity from mountain reservoirs, but in the extremely dry periods for some years past has been compelled to use the Antietam creek as an auxiliary supply, and in 1902 built a pumping and filtration plant on this stream very close to the pipe lines carrying water from the mountain.

At the time of the building of this plant, electric power was very high and a considerable distance away, and we therefore used steam power from 1902 to 1915. By the latter date our consumption had increased to such an extent that our pumping facilities were inadequate, and after considering the cost of coal and the delivery of the same from a distance of two miles by wagons, we decided to increase our facilities by the use of electric power, which we have used for all our operations since 1915.

At the time of building the steam plant in 1902, the Washington County Water Company was the owner of the water works, having started the works in 1881. This ownership continued until June, 1918, when the city purchased the property and it is now a municipal plant.

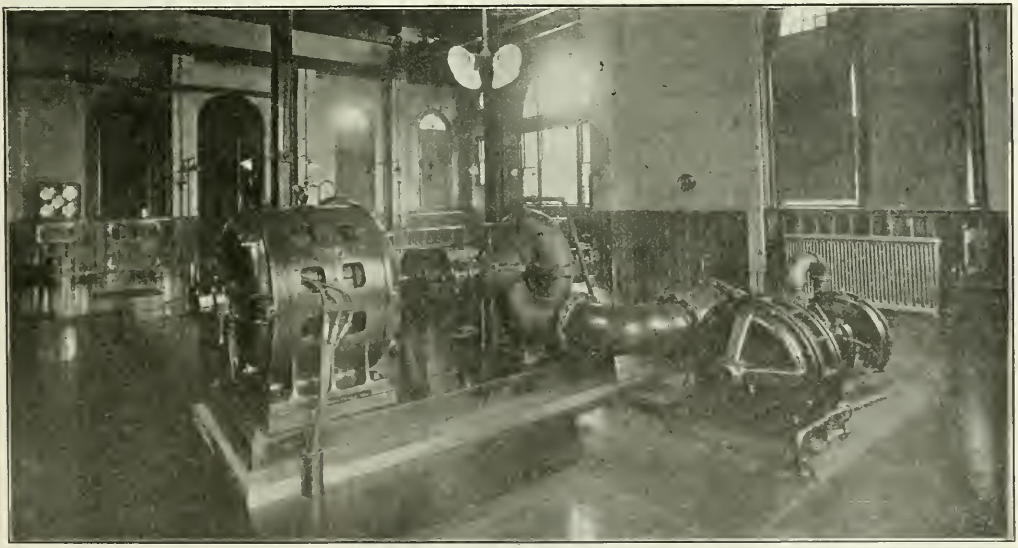
My experience has proven to my satisfaction that, as an auxiliary proposition, electricity at a reasonable price is the ideal power both as to cost and convenience, and I would hesitate to go back to steam unless it were for constant use with large equipment, and then only for efficiency, as electric power is far ahead of steam as to quickness and cleanliness.

Either of our plants can be started in 15 minutes, and with the slip ring motors which we use we can vary both pressure and quantity.

Pennsylvania Leads in Road Work

From information received by the Pennsylvania State Highway Department, it appears that state led all the others in 1919 in the total mileage of contracts let for road construction. During the year that department awarded contracts for building 679.26 miles of durable highways. Its next competitor was Illinois, which contracted for 510.70 miles. Ohio was third with 316.68 miles, followed by California, Oregon, West Virginia, Washington, Kansas, Massachusetts and Missouri in the order named. None of the others contracted for more than 100 miles. Only three—Wyoming, Iowa and Nevada—contracted for less than 10 miles.

It is claimed by the department that Pennsylvania not only contracted for, but built more miles of modern-type highways than any other state in the Union.



New Electric Unit at Elmira, N. Y., Water Works Pumping Plant.

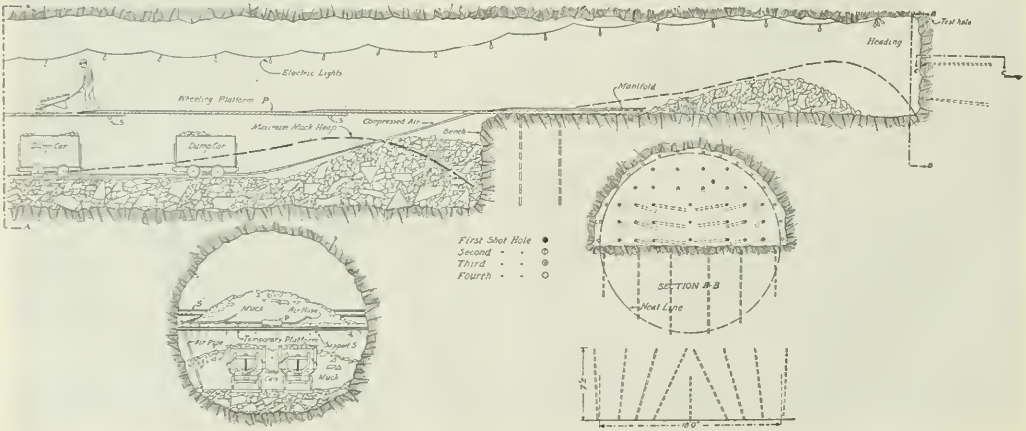
The pump in the right foreground is a small sump pump, given undue prominence by the photographic distortion.

Fourteenth Street Tunnel, New York

Nearly three miles of single track tunnels costing about six million dollars, driven under the East River, New York, to connect the subways in the boroughs of Manhattan and Brooklyn. About one hundred and twenty thousand yards of earth excavated under maximum air pressure of 38 pounds by use of eight one-hundred-ton steel shields, each advanced by hydraulic jacks capable of exerting four million pounds thrust. The shields, in sets of four, were assembled in steel-lined shore shafts, which were afterwards closed above the shields, the latter driven through openings in the walls of the shaft bulkheads built closing the tunnels behind the shields, and the shafts opened to atmospheric pressure. Where the tops of the tunnels are above the original river bottom the shields were driven through and under a blanket of clay forming an artificial roof thirty feet thick. About seventy thousand yards of rock were excavated under atmospheric pressure.

One of the lines of the New York Rapid Transit Subway system crosses under the East river at the foot of Fourteenth street, Manhattan, in two single track tubes about 30 feet apart on centers that are 3,435 feet long between shafts and extend beyond the shafts on both sides of the river to provide a total length of 14,178 feet of single track tunnels. Two land headings were also driven through soft ground under compressed air, 1,627 feet landward from the Manhattan shaft and 2,025 feet landward from the Brooklyn shaft.

For a distance of about 1,000 feet under the center of the channel where the tunnels pass entirely through rock, the cylindrical cast iron lining is 17 feet 2 inches in exterior diameter, and the sections of the segments have 7-inch flanges and webs one inch thick. For a distance of 560 feet in each tunnel the cast iron lining will be omitted, and the concrete lining will be built directly against the rock excavation. For the remainder of the tunnel, which was driven by the shield method, the cylinder is 18 feet in exterior diameter and the segments have 9-inch flanges and 1⅜-inch webs. The tunnel will be lined with concrete for its full length, the thickness of the concrete varying so that the inside diameter will be 15 feet for a length of 560 feet where there are no rings and will be 15 feet 6 inches for the light and heavy rings respectively.



Longitudinal and Cross Sections of Rock Tunnel, Showing Locations of Drill Holes and Method of Drilling and Handling the Muck on Invert and Bench.

The tunnels have a maximum grade of 3.22 per cent. There is one 30,000-gallon sump and a pumping chamber under the middle of the river and the tubes are connected at several points by transverse passages. The principal quantities involved include about 120,000 yards of earth excavation, 70,000 yards of rock excavation, 50,000 yards of concrete and 40,000 tons of iron lining. The work was designed and its construction is directed by the Engineering Department of the Transit Construction Commission, D. L. Turner, chief engineer, Robert Ridgway, engineer of subway construction and C. D. Drew, engineer in charge at the present time. The work was commenced under the direction of Alfred Craven, then chief engineer, Robert Ridgway, engineer of subway construction, and C. M. Holland, then tunnel engineer. The work was awarded to Booth & Flinn, Ltd., for a contract price of about $6,000,000 and was to have been finished in 27 calendar months, but the contractor has been unable to finish the work in that time due to war conditions.

INSTALLATION OF SHIELDS.

Each of the two tunnels has been excavated with four headings, two of them being simultaneously started in opposite directions from the feet of the double shafts on both sides of the river that were sunk by the pneumatic caisson process.

This required the installation of eight steel shields 18 feet 6 inches in diameter, that with their equipment weighed about 104 tons each and were manufactured by the American Bridge Co. Each shield was equipped with 17 Watson-Stillman hydraulic jacks with a maximum thrust of 125 tons each under 4,500 lb. per square inch pressure, which were operated by electrically driven hydraulic pumps in the power houses near the shafts.

After the shafts were sunk to the required depth and the bottoms were sealed with a heavy concrete floor the air pressure was released and the heavy plate girder and buckle plate roofs over the working chambers were removed. A shield was then assembled at the foot of each of the two shafts in each caisson, four shields in all, and the roofs were replaced at a higher elevation giving clearance below them for the operation of the shields. Air pressure was again applied, and the circular bulkheads in the shore and river walls of the caissons were removed, permitting the shield to be advanced through them on the center lines of the tunnels.

When the shields were sufficiently advanced, concrete bulkheads, 10 feet thick, each of them engaging 5 complete rings of the cast iron lining, were constructed in the rear of the shields, about 70 feet from the shafts, and in them were placed material locks, manlocks, an upper emergency lock, and the necessary pipes and conduits. Air pressure was then released in the shafts and the rocks removed, leaving the shafts open to the air. Then the remaining four shields were assembled on the cradles at the foot of each shaft, the roofs again placed over them, air pressure resumed, and the shields sent out through the caisson openings in directions opposite to those referred to the first four headings. Again the roofs were removed, this time permanently, after the shields had advanced 100 feet and concrete bulkheads built behind them.

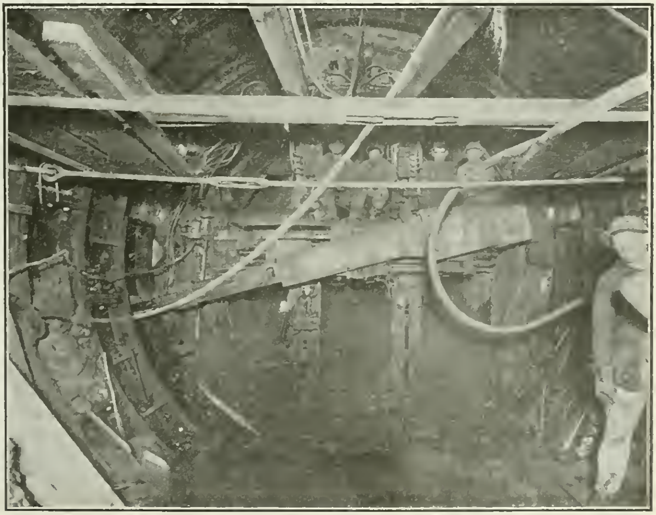
SHIELD EXCAVATION.

The shields were advanced in the usual manner under maximum air pressure of 38 lb. with which continuous operations were maintained by sixteen 1½-hour shifts daily. The shift for each heading consisted of 25 to 30 men who worked two shifts a day with 3-hour rest intervals between shifts. Great care was taken in the examination and direction of the men to see that no physically unfit laborers were employed, that they were properly cared for, and especially that sufficient time was taken in the decompression as they emerged from the tunnel. This was regulated by the lock tender who allowed the full time prescribed in the labor laws of New York State for the trip out. A 7x30-foot hospital lock was maintained on each side of the river with a competent nurse, and physician always in attendance, and all cases of the bends were so successfully treated that no serious injuries or fatalities resulted from them.

The shields advanced about 600 ft. to 800 ft. from the shafts, until they had penetrated their full length into solid rock, where they were finally stopped and were dismantled, the cylindrical shells remaining permanently in position. The iron lining was assembled inside of them and grouted solid on the exterior. The second set of bulkheads were then removed and the remainder of the excavation between headings in each tunnel was blasted in the usual way in free air.

SAFETY DIAPHRAGMS.

While the shields were being driven under air pressure transverse steel plate safety diaphragms about 6 ft.



View of Rear of Shield in Position, Showing Upper Platform Radial Arm for Erecting Heavy Lining Segments.

deep, were always maintained, bolted to the upper part of the segmental rings to form roof barriers sufficient to maintain air pockets in the event of the tunnels being flooded. These diaphragms were so arranged that the elevation of the bottom of the diaphragm was about 2 feet below elevation of top shield. An elevated gangway 3 feet wide with a hand rail on one side was maintained to the working face and between the diaphragms for the use of the men in case of emergency but fortunately was never needed.

SHIELD EXCAVATION.

The miners worked on a floor 2 feet above the bottom of the shield and on an upper platform, excavating in front and loading the muck in 1-yard dump cars hauled through the tunnel by 20-inch gage storage battery locomotives. In each shaft the muck cars were hoisted to about 20 feet above the surface of the ground and then run on elevated platform tracks to the dumping board established in the adjacent slip where they discharged their contents through hoppers to the barges moored alongside.

ROCK EXCAVATION.

After entering solid rock the drifts in each of the four headings were excavated under atmospheric pressure by the ordinary top heading and single bench method using two column drills in the heading and two jackhammers on the bench, all supplied with air from a high pressure pipe line carried on the invert and on the top of the bench and requiring in 24 hours from 34 to 48 men to fill the three shifts.

The drilling and mucking shift working from 8 a. m. to 4 p. m. commenced operations by removing any remainder of muck that obstructed the tunnel and drilled a total of 60 holes from 7 to 9 feet deep. The 47 holes in the top heading were inclined slightly from the horizontal as indicated in the diagram, and served to blow out a semi-circular cross-section approximately 20 feet in diameter, averaging 1 foot beyond the neat line to which payment was made for the excavation. Transverse rows of six vertical holes were drilled in the bench at intervals of 4 feet and the rock was shattered sufficiently to be loaded by hand into dump cars running on double track narrow gauge service lines laid on the invert and over the top of the muck pile to a point near the bench. The typical drill gang comprised four drill runners, four drill runners' helpers, two hand drill runners, two nippers, one mucker foreman, eight to ten muckers, one electrician and one pipe man.

BLASTING.

The blasting was done in four shots. The first shot consisting of three buster holes, from 4 to 7 feet long, on the vertical center line of the cross section, and 6 cut holes, 3 on each side of the center line, each of both sets of holes being loaded with eight 9-oz. sticks of 50 per cent gelatine dynamite. The first shot also included the first row of bench holes loaded with six sticks each.

The second shot included the second row of bench holes each loaded with six sticks of dynamite and ten holes in the heading of which the four reliever holes in the horizontal row just above the first-shot holes were each loaded with six sticks of dynamite and the three holes in the vertical rows each side of the first shot hole were each loaded with eight sticks of dynamite.

In the third shot one lower hole on each side of the heading was loaded with eight sticks of dynamite and the remaining holes, all of them reliever holes, were loaded with six sticks of dynamite each.

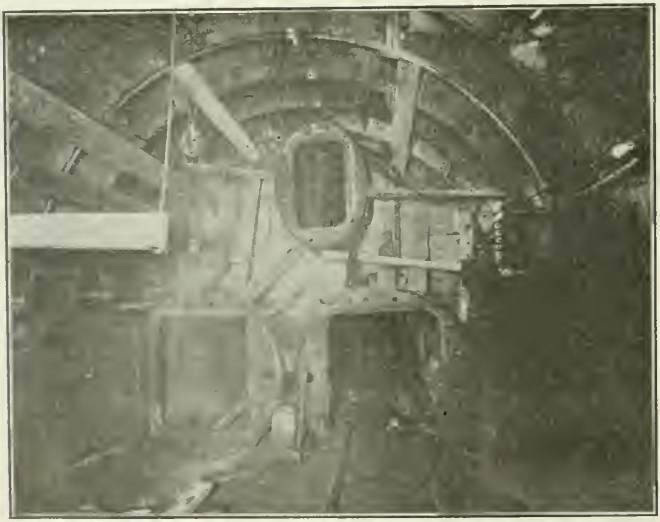
For the fourth shot the sixteen trimming holes outside the neat line of the tunnel section were loaded with different numbers of sticks of dynamite varying from eight sticks at the springing line to four sticks at the roof.

The 47 holes in the top heading and the bench required together an average of 225 lbs. of dynamite and required a blasting gang, consisting of 1 foreman and from 4 to 6 men who worked from 4 p. m., till 12 a. m.

PROGRESS OF WORK.

The average daily advance of the heading was 7 feet in three eight hour shifts, removing 11.06 yards of solid rock per linear foot, an amount which expanded from 60 to 75 per cent when broken.

As the work advanced, test holes about 9 feet long were drilled in the roof at an angle of 45 degrees, at intervals of about 14 feet, to determine in advance the presence of open seams in the rock, and at the springing line, horizontal telescopic pipe struts were set to carry a gangway at the level of the top of the bench, on which the muck from the bench was wheeled by hand and dumped into cars on the invert tracks. The mucking gang, consisting of 1 foreman, 8 to 14 muckers, 1 electrician, 1 pipe man, and 1 pump man worked from 12 a. m. to 8 a. m.



View of Second Bulkhead.

Emergency air lock on top; suspended beam for safety platform at left.

ROOFS AND BLANKETS.

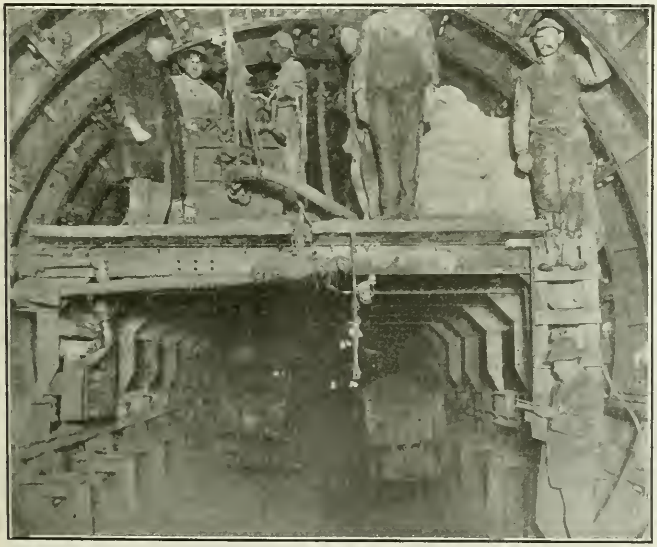
On the Brooklyn side of the river where the top of the tunnel is above the original bottom of the river, there was deposited a clay blanket 30 feet in maximum thickness and 125 feet wide, that covered both tunnels for a length of about 700 feet and contained about 100,000 yards of clay protected by rip-rap. It proved adequate to retain the air pressure and permitted the shields to be driven forward until they penetrated the inclined rock stratum.

In some places the rock roof over the tunnels was very thin with a minimum of about 4 feet of sound material overlaid by soft and decomposed rock. Here the excavation was carried on with extra care and very light charges of explosives were used. Every 10 feet the rock was sounded by the 45 degree test, holes drilled in the roof. The best record was made 220 linear feet for the river tunnels on the Manhattan side in January, 1918, and 275 linear feet for the land tunnels on the Manhattan side in March, 1918.

CONCRETE LINING.

On each side of the river there was installed a concrete plant equipped with a ½-yard electrically driven mixer and storage bins of 200 yard capacity for the premixed sand and graded gravel that were delivered on barges and unloaded by clamshell buckets. The aggregate was transferred from dump cars running on the overhead platform and emptying into the charging hopper, and the mixer installed in the upper part of the shaft. The mixer delivered through a 6-inch steel pipe to 1-yard dump cars in the bottoms of the shafts, that were hauled by the electric locomotives.

For the invert the concrete was dumped directly on the bottom of the cast iron lining, shoveled to place and screened to the required upper surface. These operations have been completed on the Manhattan side of the river and have been commenced on the Brooklyn side. The invert is to be followed by the building of the duct banks and concreting after which the remainder of the side walls and the arch will be concreted in 100 foot sections using Blaw steel forms shifted on carriages rolling on tracks. The approximate cost of the tunnel, including the shafts, is about $460 per linear foot of single-track tunnel.



View in Tunnel at Shaft No. 4.
Shows trailing group platform in rear of shield with under clearance for muck cars. Grout pressure machine on upper deck.

Oregon Highway Engineers' Salaries

The Oregon Legislature has removed the limit of $5,000 per year for the salary of the state highway engineer, and is expected to pass, during the present session, a bill amending the salary limit of county surveyors throughout the state and providing that the salaries be fixed by the county commissioners. At present the pay is fixed at $5 a day.

Protecting a Machine-Excavated Pipe Trench

Trench for 30-in. drain pipe was excavated in very soft ground to a depth of 7 ft. by a No. 0 Austin Steam Trench Machine near Marengo, Ill. The ground was so bad that the sides of the trench would not hold up after the excavating machine had passed and the pipe was laid and jointed.

Protection for the pipe was provided by two sections of vertical wall about 12 ft. long, and 7 ft. high that were made of horizontal boards nailed to inside vertical cleats and spaced about 3 ft. apart, the normal width of the trench, by adjustable horizontal braces. A vertical frame was made fast to the forward end of these walls and braced to the trench machine, the latter being set with its buckets just even with the front of the walls.

The walls were attached to the machine that pulled them forward as it advanced, always maintaining them in the same relative position so that they served as a set of traveling sheeting advancing with the machine and protecting the sides of the trench from caving in immediately in the rear of the machine. Between these walls the pipe was laid and jointed and lightly covered as fast as the excavation was made. After the machine had passed and the pipe had been laid, the removal of the walls permitted the banks to cave in when it would no longer affect the work. With this apparatus contractor Monroe Farrar dug 1,200 ft. of trench per day with five men.

Nails for Concrete Forms

Doubledheaded nails having only one stem and two fixed heads about one-quarter inch apart have been found very convenient for fastening concrete forms that have to be stripped and re-assembled. The nails are driven in until the lower head engages, leaving the upper head projecting and this makes it convenient to be gripped by a claw and gently pulled out.

Minnetonka Boulevard, Between Minneapolis and Lake Minnetonka.
Length 11.8 miles; average width 22 feet. Received three hot applications of Texaco liquid asphalt No. 1, each ⅛ gallon per square yard, covered with sand and gravel. Work completed by Hennepin County Commissioners in August, 1919. Photograph taken October 3d.

Oiling Hennepin County Roads

By E. E. Terrell.*

Up to a few years ago we applied a light oil in the usual way to our roads, but apparently accomplished nothing but laying the dust for a few weeks and securing a miserably rough road which was very difficult to repair. The use of oil on roads applied in that way seemed anything but a success.

In analyzing the cause for oiled roads picking up in numerous places, thus leaving the surface very rough, I came to the conclusion that the trouble was due to dust or loose material under the oil, and that the remedy was to sweep the dust or loose material to the side and apply the oil to the clean, solid surface. I told Mr. Waddell, chairman of the Road and Bridge Committee of the County Board, my conclusions and he said to go ahead and try it out.

Excelsior Boulevard, Hennepin County.
Three hot applications of ⅛ gallon each of Texaco liquid asphalt No. 1, covered with sand and gravel. Dirt road base. Completed August, 1919.

When we first tried it out, after oiling, we gathered the dust and loose material in from the side of the road with a blade grader and covered the oil. This treatment began to show results. When not enough material can be swept from the road to cover the oiled surface, we haul fresh, clean gravel along the sides for a covering. We always try to cover the surface immediately after applying the oil. We seldom apply oil, now, without covering it with sweepings or something better.

This past summer we scarified all our previously oiled roads as shallow as it was possible to do. After scarifying, the road was scraped with a large grader and well compacted with rollers. I consider the most favorable time to apply oil is immediately after the compacting, first sweeping all loose material from the surface; but we did not have the oil at that time, so had to apply it after the road had taken considerable traffic.

We had about three and one-half miles of broken stone macadam which had become so rough that traffic detoured to avoid it. This was scarified about two to two and one-half inches deep, put in shape with a "Giant" grader and the surface set by rolling. Seven-tenths of a gallon of about 70 per cent asphalt oil per square yard was then applied.

After the oil application the surface was covered with screened gravel ranging in size from pebbles retained on a quarter inch screen to pebbles passing a one-half inch screen, and then well rolled. This piece of road was almost like a pavement when completed and was in splendid condition when winter set in.

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*County surveyor of Hennepin county, Minnesota.

In the construction of oil roads, we use nothing but heavy asphalt oil, 65 to 80 per cent. I would like the lighter grade first on gravel roads, and after the surface has been well formed, the heavier grades are preferred.

Heating is an important part of the work. The oil should be heated as hot as it will bear without burning.

To name the different parts of the work of treating a road with oil, in order of their importance, I should like to say:

First, get a good, reliable grade of heavy asphalt oil.

Second, sweep the surface clean.

Third, cover the surface with pea rock, rock screenings or clean, coarse sand as soon after applying the oil as it is possible to put it on; and

Fourth, the surface may be rolled after the covering is put on.

Paving an Arid, Rockless District

By Frank Reed

The absence of water was met by using asphalt as a binder; the absence and cost of rock, by using as an aggregate only dune sand, which was abundant alongside the road. Part of the stretch was laid on a fill across a slough, part on an old macadam pavement. Heavy traffic has been carried on this pavement for several months.

The city of Los Angeles, California, and the port of San Pedro are connected by Harbor Boulevard. Most of this highway has been paved with oil-bound macadam, but a fill across "Nigger Slough" has remained unpaved because it has settled each year, at the time of the spring rains, sometimes as much as three feet. This stretch was paved last summer.

This highway carries a very heavy traffic as compared with most western roads. A traffic census taken by officials of Los Angeles county between July 1st and November 1st, 1919, showed a total of 502,583 automobiles, of which 59,783 were trucks. The vehicles averaged 4,086 per day and the average daily tonnage was 6,043. There is a large shipyard at the harbor, where several ships are constantly under construction, and the heavy steel for these is trucked over the boulevard. Figures are available of one heavy haulage unit consisting of a specially constructed trailer weighing 6 tons and carrying a load of 20 tons, drawn by two trucks, each weighing 6 tons and carrying a 7-ton load; a total weight of 52 tons.

Local conditions here, like those in a considerable part of the southwest, include absence of both water and rock, thus making excessive the cost of concrete for either base or finished pavement.

The pavement laid last summer included the fill across Nigger Slough and the surfacing of some old macadam, totaling approximately a mile in length. The material used was that known as "Willite," which used as the sole aggregate the light, drifting sand, a trifle loamy,

Mixing Plant; Old Oil-bound Macadam Section of Boulevard.

Machinery on Truck and Trailer on Harbor Boulevard.

found along the highway, and a binder of asphalt treated with copper sulphate, this binder being the special feature of this kind of pavement. The dune sand used was subjected to sieve analysis, with the following result:

Passing 200-mesh	6 per cent
Passing 100-mesh and retained on 200	48 per cent
Passing 80-mesh and retained on 100	28 per cent
Passing 60-mesh and retained on 80	14 per cent
Passing 40-mesh and retained on 60	3.5 per cent
Passing 20-mesh and retained on 40	1.0 per cent
Retained on 20-mesh	0.0 per cent
	100.5 per cent

No broken stone was used, and the only water used was for the steam boilers of the road roller and asphalt plant and for the men and animals on the job. The mixture consisted of the following, for a 747-pound box:

Sand	650 pounds
Asphalt	75 pounds
Limestone dust	20 pounds
Sulphate	2 pounds
	747 pounds

No hauling was required for 87 per cent of the material, the sand being dragged to the mixing plant from the dunes near by by means of Fresno scrapers. The cost of the mineral aggregate, delivered in the mixer, was figured by the contractor's cost accountant at less than 40 cents a cubic yard.

The pavement was made 5 inches thick where laid directly on the dirt surface of the unpaved road, and a 2-inch surfacing was laid on the old macadam.

METHOD OF CONSTRUCTION.

The mixing plant is only slightly modified from the familiar asphalt plant. The mixing bucket is somewhat larger, to admit of the effervescence which takes place when the copper sulphate is added to the heated asphalt. The heated asphalt is delivered by force pump, the sand is handled by automatic conveyor, and delivery to truck is made automatically on completion of the mix by opening the bottom of the pug mixer. The material was loaded onto the trucks at about 320 deg. F.

On this job, after the hot material had been spread, all rolling took place lengthwise of the highway, it being impossible to undertake the customary cross-rolling on account of the pavement extending close to the sides of the fill.

In the 5-inch section on dirt, as this thickness could not be rolled at a single operation, the job was done in two layers, a 3-inch base, with a 2-inch covering.

The 2-inch pavement laid over an old macadam foundation was placed after the top of the old road had been scarified and a 12-ton roller used for leveling and scraping.

This paving was begun May 28th and completed July 1st. It was opened to traffic a few hours after completion.

SERVICE GIVEN.

Since its completion the pavement has received a daily

Two-inch Pavement on Old Macadam After Several Months Use.

connection pounding by the heavy traffic described above. The traffic is carried at the full rate of speed of the vehicle, and as it is continuous and the pavement is only 20 feet wide and vehicles pass each other at very close intervals of time, the drivers practically follow in a track, so that wheel impact is not very much distributed over the surface.

This pavement has several times been subjected to extreme stresses of heavy combination truck and trailer loads. There has been a great deal of movement of lumber and other heavy commodities over it, and all of these commodities are commonly hauled with truck and trailer, or truck and two trailers.

At the present time the pavement shows no signs whatever of any cracks and it has withstood the effects of traffic during the extreme summer heat of southern California without rutting or waving. In fact, one of the claims made for Willite is that it sets so firm that it is not affected by heat, the effect of sulphate treatment being to lower the penetration of the completed pavement without increasing brittleness.

About twelve days after the completion of the work some slipping was noted between the upper and lower courses. An inspection showed that the failure to properly bond was due to dust which had drifted onto the completed lower course before the top 2 inches had been applied. Accordingly it was determined to remove as much of the 2-inch upper course as could be pried off with crowbars, and resurface after first treating the exposed surface of the 3-inch base to insure bond. This was done by roughening with picks and applying a "paint coat," after which a new 2-inch surface was immediately spread and rolled.

Since the original completion of the job there has been no indication of any separation from its base of the 2-inch surface laid over the old macadam foundation; nor has the relaid 2-inch top course in the 5-inch pavement shown any signs of trouble.

Sewage Filters from Refuse[*]

By W. Scouller, M.Sc., A.I.C.[†]

A bank of refuse, dumped as a fill in Chester, England, was leveled off and used as a sewage filter, with such success that the corporation expects to greatly extend their use of such material. Leek, England, has been practicing the same method for sixteen years. The chemical effect of the treatment is described.

House refuse has been disposed of at Chester for many years by raising low-lying land 10 feet and covering with a top layer of 6 inches of soil. About six years ago the height of the refuse was reduced to 4½ feet, and the top layer of soil and subsoil increased to 18 inches, and good crops have been obtained by this method. In 1904 four acres of land on the sewage works site were covered with house refuse 10 feet high, with the intention of building storm water filters thereon. In 1910 a scheme of sewage works extensions was got out, which included the building of filters on this house refuse area. The cost was found to be heavy, and after alternative schemes had been drawn up and discussed, I decided to try the effect of direct filtration through the refuse bank. A section of the bank was accordingly dug out and placed in an experimental filter, 3 feet in diameter and 7 feet 6 inches deep. The refuse was ten years old, and consisted of ashes, bottles, crockery, bones, iron cans and general garbage. The filter was started in January, 1914, and treated crude sewage at the rate of 100,000 gallons per acre per day. On March 7th, 1914, the rate of treatment was increased to 200,000 gallons of crude sewage per acre per day. The resulting effluent was of most excellent quality. The free ammonia almost entirely disappeared, and the nitrate was large. The rate of disappearance of dissolved oxygen in five days was small. The permanent hardness, however, was very high, and was mainly due to the solution of $CaSO_4$ from the refuse. An estimation of $CaSO_4$ in the refuse used was not made, but over half a ton of this substance was dissolved out of the refuse per 100,000 gallons of sewage treated.

The analytical results are as follows:—

Analysis of Experimental Refuse Bank Effluent

Parts per 100,000	Crude sewage	Effluent		
		Feb. 1914*	Mar. 1914†	Apr. 1914†
Free and saline nitrogen	2.86	0.012	0.005	0.005
Albuminoid nitrogen	0.867	0.029	0.022	0.018
Nitric nitrogen	....	3.1	5.0	4.8
Oxygen absorbed in 4 hrs. at 80° F.	11.68	0.38	0.40	0.40
Disappearance of dissolved oxygen in 5 days at 18.3° C.	....	0.20	0.07	0.06
Hardness, temporary	....	8.0	....	....
Hardness, permanent	....	162.0	....	....

* 100,000 gallons per acre per twenty-four hours.
† 200,000 gallons per acre per twenty-four hours.

In May, 1914, the experimental filter having proved so successful, half an acre of the refuse bank was prepared and tank effluent distributed over it at the rate of 150,000 gallons per acre per day. The bank is not underdrained, and a well was sunk in it to enable a sample of the effluent to be collected at a depth of 4 feet The results were excellent and confirmed the experimental filter. The analytical results are as follows:—

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[*] From "Municipal Engineering and the Sanitary Record" (England).

[†] Chemist and Manager of the Chester Corporation Sewage Works.

Analysis of Refuse Bank Half-Acre Filter

Parts per 100,000	June, 1914	August, 1914
Free and saline nitrogen.........	....	0.024
Albuminoid nitrogen.............	....	0.029
Nitric nitrogen	1.3	2.86
Oxygen absorbed in 4 hrs. at 80° F.	0.58	0.66
Disappearance of dissolved oxygen in 5 days at 18.3° C..........	0.15	0.19

It now became necessary to know if fresh town refuse could be used for filtering sewage. The experimental filter was therefore emptied and refilled with house refuse fresh from the city in January, 1917. The weather was very frosty, but in six days nitrates appeared in the effluent, and in sixteen days the effluent was of good quality. These results were very surprising, when one considers that the refuse consisted of ashes, rags, old boots, bottles, bones, crockery, tin cans. etc. The filter, in fact, gave similar results to the old refuse filter, and is doing so to the present day. The average results of a number of analyses are as follows:—

Fresh Town Refuse Experimental Filter

Parts per 100,000	October, 1917
Free and saline nitrogen.......	Trace
Albuminoid nitrogen............................	0.032
Nitric nitrogen	3.8
Oxygen absorbed in 4 hrs. at 80° F.............	0.41

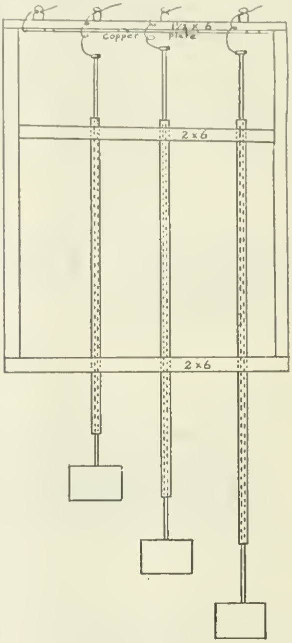
The scheme for using house refuse for sewage filters is briefly as follows:—The land will be underdrained and the refuse raised 10 feet with a top layer of soil 6 inches deep to act as a distributing layer for the sewage tank effluent. The present method of adding 18 inches of soil to the top of 4 feet 6 inches of refuse will be discontinued, as it would considerably lower the rate of treatment, and, in fact, make it into a land filter. Incidentally, the change-over will save the labor of four men at the tip.

Note: The Chester Corporation has applied to the Ministry of Health for approval of a loan of $90,000 for purchase of land for extending the method of sewage treatment. After this article was written it was learned that Leek, England, had been practicing the same method for sixteen years.

RESERVOIR WATER-LEVEL GAUGE.

Having seen the description in our issue of November 29, 1919, of a gauge by which the engineer at the pumping station can tell the height of water in the reservoir, C. M. Hooper, superintendent of the water department of Pullman, Wash., sends us a description of one of an entirely different kind which he installed in the reservoir of that city in 1914 and which he says has worked perfectly.

The appliance consists of a rectangular frame 4 feet wide by 5 feet high made of 2x6 timbers. In this are set, in a vertical position, three 1-inch gas pipes (or as many more as may be necessary) inside of each of which pipes is passed a round stick of wood of such size as to move freely, each stick carrying at the bottom a float and at the top a piece of brass. A copper plate two or three inches wide and about three feet six inches long is fastened under the upper timber of the frame, but insulated from it. On top of the same timber are four insulators. To each piece of brass on the top ends of the sticks above referred to is fastened a wire, which is carried to the pumping station and there connected to an electric light signal, to be described. Each wire is attached to one of the insulators on top of the frame, with a loop between this and the brass tip referred to, to permit several inches' vertical motion in the rod. A fourth wire is attached to the copper plate and, first being fastened around the fourth insulator, is also carried to the pumping station.



Reservoir Water-Level Indicator.

Each of the rods referred to is provided with a pin which prevents the brass tip from dropping more than two or three inches below the copper plate. The rods extend to different depths. As the water rises to the float on the longest rod, it raises this until there is contact between the brass tip and the copper plate, which of course closes the circuit. This remains closed until the water again falls below the float. If the water rises to the second float, this in turn forms a contact, and similarly with the third float.

In the office at the pumping plant there are three electric lights connected respectively to the wires from the three floats, so that, as the water raises each float to complete the circuit, the corresponding light is switched on. The reservoir referred to is one mile from the plant and the wires are carried between the two on the standard poles and cross-arms used in connection with the city lighting system.

Cost of Horse Maintenance

Itemized costs as reported by ten cities are analyzed, estimates made of values for depreciation, insurance and other charges, allowance made for days horses are not working, and a charge for team and driver of $8 to $10 a day considered proper.

Like everything else, the cost of keeping horses and mules has risen during the past few years. The figures of two or three or four years ago are of little use now as a standard for estimating equine expenses; in fact there are no figures really available. In the past, a main reliance has been upon the reports of those departments of the larger cities where horses or mules in considerable number are kept. But, unfortunately, the vast majority of municipal reports are from six to twele months late in appearing, which makes the data contained in them more valuable for record than for use. These reports, however, are practically the only place where such figures can be found, and an attempt will be made to present such data as may have value and to arrange it so that by taking into account local conditions and prices, a reasonable estimate can be made.

Of the expense of keeping such animals as horses and mules, approximately two-thirds will ordinarily represent the cost of feed, such as hay, oats, etc. (That this does not always hold is evidenced by the Boston and Cincinnati costs given later.) The remainder is taken up by the direct labor cost of caring for the animals and by the overhead, such as maintaining the stables, etc. The cost of replacing worn-out horses—depreciation—is taken into account by only one city (Rochester, N. Y., in a recent report), though it ought to be by all; and the same is true of interest on the first cost and insurance. In arriving at any accurate estimate of the actual cost of the horse per day, these figures should be included, as should the number of days the horse actually works. Probably there are few muncipal horses that work more than 260 days in a year, though they have to be maintained for 365 days.

The average rations for horses employed in the street departments of several cities are given below. This may be assumed as the standard for animals on heavy work. It is quite the usual custom to halve the oat ration when not actually working. All rations are given in pounds per day.

City	Hay	Oats	Other Feed	Straw
Rochester	22	11		
New York	18	23	3½ (bran)	3
Chicago	20	10	¾ (bran)	1/10 bbl. shavings
Columbus (1915)	31	12¾		6 1/3
Columbus (1916)	30	12		5 1/3
Cincinnati (1917)	16	11.8	3 (nutritia)	
Cincinnati (1918)	15.8	12.2	3.1 ”	
Washington (1915)	14		1.7 (bran)	3 1/3

These figures indicate an average ration of 20.8 pounds of hay, 13 pounds of oats and 2 pounds, more or less, of other feed, with about 5 pounds of straw for bedding. By taking into account local prices, it is possible to figure, with a fair degree of accuracy, the cost of feed.

For purposes of comparison, figures will be given for various cities, which have been selected with a view of showing the rise in costs, and also of covering the country fairly well.

FIGURES FROM ELEVEN CITIES.

Washington, D. C., year ending June 30, 1919. Costs on 51 horses and 32 mules show a feed cost of $21.94 per month and a cost of shoeing of $1.35 monthly. No account taken of labor, replacements, interest, or maintenance.

St. Louis, Mo., year ending April, 1918. Costs $263.06 per year per horse or mule. Figures monthly are as follows: Feed, $14.75; shoeing, $2.84; labor $4.33; total, $21.92. No other items included. Costs for previous year were $12.19, labor included, per month.

Savannah, Ga., year ending Dec. 31, 1917, cost for feeding alone was $14.50.

Boston, Mass., year ending Jan. 31, 1918, costs for 29 horses in sewer department were $1,638 per day, made up as follows: Labor, 76.7 cents; hay and grain, 67.1 cents; shoeing 15.1 cents; veterinary services, medicine and clipping, 3.2 cents; stable goods, 1.78 cents.

Horses in Boston.

Costs for Sanitary Department, 1917-18. Cost per Horse per Day on a Basis of 365 Days per Year.

Districts.	South Boston.	East Boston.	Charlestown.	Dorchester.	Roxbury.	South Stable.	West Stable.	Total.
Average No. of Horses Kept.	20.26	15.6	12.06	14.4	19.4	64	32.1	177.95
Labor	$0.6282	$0.5479	$0.6609	$0.746	$0.4534	$0.5699	$0.4708	$0.5521
Hay and grain......	0.6053	0.7033	0.7307	0.547	0.7179	0.7322	0.744	7052
Fuel	0.0179	0.0071	0.0156	0.0363	0.0057	0.0005	.....	0.0076
Light	0.0079	0.0106	0.0125	0.0096	0.0302	.....	.....	0.0067
Rent and taxes......	0.1217	0.4111	.....	.....	.....	.....	.....	0.0498
Yard and stable repairs......	0.0277	.....	0.0556	0.0443	0.0468	0.0282	0.0224	0.0282
Yard and stable furnishing......	0.0276	0.0159	0.0197	0.0304	0.0252	0.0453	0.0196	0.0309
Veterinary service and medicine....	0.0191	0.0179	0.0163	0.0007	0.0005	0.0003	0.0154	0.0058
Horseshoeing and clipping......	0.14	0.1594	0.1692	0.0945	0.0897	0.1183	0.1124	0.1217
Totals	$1.6362	$1.8712	$1.6802	$1.5081	$1.3695	$1.9515	$1.3747	1.5067

Rochester, N. Y. In 1918, Rochester states the average cost of the hay ration per horse to be 38.7 cents and of the oat ration 32.7 cents per day. The cost for maintenance of all kinds was $1.17 per horse per day, or $458.01 for the year. For 1917, the annual cost was given as $336.65. The cost of shoeing in 1917 is set at 12 cents per day and the stable operating cost 21 cents.

Columbus, O. The cost per day per horse has increased from 83 cents per day in 1915 to $1.176 in 1918. Itemized costs for the four years are:

	1915	1916	1917	1918
Feeding and bedding	$0.4577	.4163	.5340	.6727
Labor, harness, supplies, veterinary	.2922	.3263	.3263	.3925
Shoeing, etc.	.0801	.0944	.1062	.1107
Total cost per day	.8300	.8370	.9665	1.1759

Cincinnati, O. Figures for the year 1918 show a cost close to that given by Columbus. For purposes of comparison, figures for the same four years are given.

	1915	1916	1917	1918
Cost per horse day for feed	$0.382	.349	.490	.633
Other stable expenses, per horse day	.368	.393	.411	.465
Cost of maintaining horse per day	.750	.742	.901	1.098
Horses idle, average, days per month, (excl. Sundays)	4.0	3.8	5.4	5.7
Cost of feed per days horse actually worked	.564	.515	.770	.982
Other stable expenses, horse days actually worked	.534	.579	.645	728
Cost per horse day actually worked	1.098.	1.194	1.415	1.710

Charleston, S. C. The average cost per month in 1918 for keeping horses was $19.27, which included feed only. Hay during the year averaged $1.84 per hundred and oats $1.046 per bushel.

Brockton, Mass. Jan. 1, 1920, contractor who does much of the teaming work for the city estimates cost of keeping horses, exclusive of depreciation, interest, etc., at $37.50 per month, and the useful life of a horse at 8 years.

Hampton, Va. During the latter part of 1919, the cost of keeping one mule has run from $40 per month upward. In December, 1919, the cost for feed alone was $47.50. This mule is kept in a negro section in a flimsy barn and part of the grain is known to have been stolen.

Chicago, Ill. The ration fed Chicago horses has been given previously. The first cost of a horse runs from $200 to $250, and the useful life is estimated at from 6 to 8 years. Harness costs $100 and lasts 6 to 8 years. Shoeing costs $5 per month, and veterinary attention and medicine 10 cents per day.

CALCULATION OF TOTAL COST.

It will be noted that no city, excepting Cincinnati, makes any references to the actual number of days the animal works. Taking the average of the days the horses did not work, as shown in the four years, 1915, 1916, 1917 and 1918, in Cincinnati, as a standard, the average horse works only 256 days per year. Probably a great many horses work more than this, but the point is that the per diem maintenance figures based on 365 days must be increased, in this case by 35%, to take care of Sundays and idle days, when the horse must be fed.

A careful inspection of the foregoing costs also leads to the conclusion that the costs given by many of the cities are incomplete in regard to overhead, stable costs, etc. None of the cities, with the exception of Rochester, makes any estimate of depreciation and replacement of horses; and none at all makes any reference to interest on first cost. None refers to insurance. These three items are always considered in motor truck operating cost records, and are of equal importance here.

Rochester, from the following figures, estimates that the annual depreciation per horse is about $30 per year. The following figures show the annual expenditure necessary to maintain a stable of 65 horses.

COST OF HORSE RENEWALS—DEPRECIATION.

Year	Number of Horses	Spent for Renewals	Av. Cost per Horse Yearly
1912	65	$2219	$34
1913	65	1885	29
1914	65	4205	65
1915	66	1020	15
1916	66	1575	24
1917	68	1125	17
Average depreciation per horse per year	..	....	30.67

Allowing for the purchase of the 3 additional horses, bringing the number to 68, at a price of $275 each, the average cost of maintenance is $28.36 each. This is probably a little low. Another estimate given is as follows:

First Cost	$275	Average useful life 6 years.
Salable value	75	
Net cost	200	Average yearly cost $33.33

There may be some argument as to the useful life of a horse, and it may be contended that 6 years is too small an estimate. But with the rather generous salvage value given above, this seems fair.

Interest on a horse, taken at 5% on a value of $275, amounts to $13.50 per year. Insurance would also amount to an appreciable sum.

Averaging the costs of the three cities which seem to have the most complete records,—Boston, Columbus and Cincinnati—we have for upkeep the following figures:

ESTIMATED TOTAL COST PER DAY OF A HORSE.

Boston (1918)	$1.507
Columbus (1918)	1.176
Cincinnati (1918)	1.098
Average	1.26
35% for time lost	.44
Depreciation per working day	.12
Interest per working day	.05
Total daily cost	1.87

When the cost for maintaining a horse is $1.87 per day, the cost of 2 horses will be $3.74. Adding a driver at $3.00 and allowing 25 cents per day for the wagon, brings the actual cost to $6.99 per day.

Boston, in 1917-1918, hired teams in eleven dsitricts at an average of $3.04 per day for one-horse teams and $4.80 per day for two-horse teams. These teams were furnished by contract at the above prices. With driver at $2.75 per day, the single teams cost the city $5.79 and the double teams $7.55. St. Paul in 1918 paid 75 cents per hour. One city reports hiring teams at $4 per day, but goes on to remark that they were of unusually poor quality. This might have been expected, it seems.

A rather hasty view of the situation would seem to indicate that teams of the first quality will have to be paid $8, $9, or even in sections, $10 per day. With these prices naturally comes forward the question of the motor truck. Certainly, in view of these figures, there seems to be a still larger field of usefulness open to it.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Injunction Against Street Assessments.

(Neb.) While a city of the second class having more than 1,000 and less than 5,000 inhabitants cannot make a vaild contract for extensive street paving without the estimate required by Rev. St. 1913, § 5011, yet, where the city engineer was incompetent to make the estimate, and proper estimate was made by engineers employed by the city for that purpose, property owners cannot enjoin assessment of benefits after the paving is completed on the ground that the estimate was not made by the city engineer.—Diederich v. City of Red Cloud, 173 N. W. 698.

An assessment for street paving, contracted for by city of second class, cannot be enjoined because a street railway was allowed to remove its rails from the street to be paved instead of paving the space formerly occupied thereby, as required by Rev. St. 1913, §5110.—Id.

An assessment for street paving, contracted for by city of the second class, cannot be enjonied because the contractor guaranteed the quality of the work and to make good any defect found within five years.—Id.

An assessment for street paving, contracted for by a city of the second class, cannot be enjoined because no formal personal notice of the formation of the paving district was given property owners.—Id.

Control by City Over Street Uses—Vehicle Ordinance.

(Cal. App.) A charter, giving a city "plenary control over all uses of its streets," authorizes a traffic ordinance regulating the manner in which vehicle drivers should turn street corners.—Pemberton v. Arny, 183 P. 356.

Regulation of Excavations and Sidewalk Openings.

(Fla.) A city may regulate how excavation in the subsurface shall be made by the owner of the fee, and may regulate how trapdoors or other appliances for closing the opening shall be constructed, but may not arbitrarily refuse a permit nor place additional burdens upon the abutting owners under guise of regulation, so as to deprive him of his rights in the subsurface.—S. H. Kress & Co. v. City of Miami, 82 So. 775.

A city may require the owner of the fee in a street to procure a permit before making an opening in the sidewalk, and it may see that proper safeguards are used and that the rights of the public are not unreasonably interfered with.—Id.

Power to Regulate Load and Tire Width of Vehicles.

(Ohio) When a city has adopted a charter under which it is authorized to exercise all powers of local self-government pursuant to Const. art 18, §§ 3 and 7, the authority to locate, establish, and protect the streets within its limits resides in the municipality, and it may adopt and enforce such reasonable regulation as it deems proper.—Froelich v. City of Cleveland, 124 N. E. 212.

The state and municipalities may make all reasonable, necessary, and appropriate provisions to promote the health, morals, peace, and welfare of the community, but the means adopted must be suitable, impartial, and not unduly oppressive upon individuals, must have a real substantial relation to their purpose, and must not necessarily interfere with private rights.—Id.

Where a city has adopted a charter under which it is authorized to exercise the powers of self-government provided, for by Const. art. 18, §§ 3 and 7, it may regulate the weight of loads and width of tires of vehicles passing over its streets by virtue of the express authority conferred in the Constitution.—Id.

Street Cleaning Contract—Arbitration Clause.

(Pa.) Where a city's contract for street cleaning shows on its face that it was clearly intended to be an arbitration agreement, and an award of director of public works, as arbitrator, is set up in defense to a suit on the contract, a provision at conclusion of contract that no certificate of any city officer should bind the city will not be considered, being repugnent to the paramount intention of parties as to arbitration.—Curran v. City of Philadelphia, 107 A. 636.

Where a city street-cleaning contract contains an arbitration provision apparently so comprehensive as to include all disputes to be determined by engineer. and another arbitration provision limited to certain defined questions for determination by director, they may both stand, and matters specified in the second provision will be excepted from the more comprehensive first provision. —Id.

Where a street-cleaning contract, providing that the director of public works should pass on deductions for certain defaults, did not provide for ex parte hearings by him, his function was judicial, and it was his duty to afford the contractor an opportunity to be heard, if he wished, before making an award.—Id.

If a city was not harmed by a contractor's failure, after an award, to claim the right to a hearing before bringing suit, since, no proper award having been made because of the want of such hearing, the arbitrator may still act.—Id.

Power to Remove Official—Suit for Salary.

(Ga. App.) A municipal corporation has an incidental power to institute proceedings against, and remove from office for misconduct, all corporate officers, though the power to do so be not expressly given by the charter.—Burney v. City of Boston, 100 S. E. 28.

Where an officer summarily removed by the governing authorities of a municipal corporation admits that he refused to levy certain executions issued by the city, without showing that they were void, a finding is justified that the removal was for good cause, and the question of good faith on the part of the governing authorities is not in the case.—Id.

In instituting proceedings for the removal of a municipal officer for misconduct, the governing authorities of the municipal corporation may act either judicially or ministerially.—Id.

Where governing authorities of a municipal corporation act judicially in removing an officer, if there be an ordinance prescribing the form of procedure, the terms thereof must be adhered to and followed.—Id.

Where a municipal official is the incumbent of an office established by law with a prescribed tenure, and is not merely an appointee holding at the pleasure of governing power, in order that the act of a motion may have the effect of a judgment, notice must first have been given the delinquent official of the grounds for his removal and opporunity for a hearing granted.—Id.

A municipal officer who has been summarily suspended or discharged by the governing authorities acting ministerially may bring suit against a municipality for his wages or salary without first having been reinstated.—Id.

Where a municipal official has been summarily removed by the governing powers acting ministerially upon suit by him for the emoluments of his office, th emunicipality may defend by setting up and proving either the existence of any ground justifying the act of a motion, or that the action of the governing authorities was taken in good faith, and that the salary has in the meantime been paid. —Id.

NEWS OF THE SOCIETIES

Feb. 9-13.—AMERICAN ROAD BUILDERS' ASSOCIATION. Annual convention, Louisville, Ky. Secretary, E. L. Powers, 150 Nassau street, New York.

Feb. 11.—NEW ENGLAND WATER WORKS ASSOCIATION. Monthly meeting at Boston, Mass. Secretary, Frank J. Gifford, Dedham, Mass.

Feb. 16-18.—INTERNATIONAL CITIES AND TOWN PLANNING ASSOCIATION. Annual meeting, London, England. Honorary secretary, C. B. Purdon, 3 Grays Inn Place, London, W. C., England.

Feb. 20-21.—AMERICAN CONCRETE PIPE ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, G. E. Warren, 210 South LaSalle street, Chicago, Ill.

Feb. 25.—NEW JERSEY SEWAGE WORKS ASSOCIATION. Annual meeting, Trenton, N. J. Secretary-treasurer, Frederick T Parker, Guarantee Trust Bldg., Atlantic City, N. J.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth annual convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

Oct. 4-8.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln avenue, Valparaiso, Ind.

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American Association of State Highway Officials.

The fifth annual meeting of the American Association of State Highway Officials was held Dec. 8 to 11 in Louisville, Ky., more than two hundred delegates being present.

A. R. Hirst delivered the presidential address in which he pointed out the tremendous task confronting highway builders next year and outlined some of the main problems to be worked out. The need of trained engineering help to make surveys, plans and preliminary investigations and to perform inspection; the threatened shortage of materials and shipping facilities; the regulation of prices; the development of efficient construction organizations; the need of improving location and alignment—all these were discussed in the address.

Among the other subjects discussed were: A system of records of the cost of all construction and of accounting for all funds available; publicity of plans and results not only in the local press, but in the national press; care of traffic during reconstruction; touring maps for the information of the people of the state and of other states; marking of the main traveled roads, keyed to the state maps; accommodations for the traveling public in the way of garages, hotels, public parking places and comfort stations; complete knowledge and study of, and, if necessary, the design of labor and time saving devices and equipment; a study of plant layouts and equipment for various types of construction under varying conditions; a study of the grade crossing situation and a strong campaign for improved conditions; the holding of road schools and short courses for the instruction and inspiration of all classes engaged in supervising and constructing highways; helping to formulate and pass adequate highway legislation so that the states may keep pace with each other.

After the president's address the remainder of the morning session was devoted to a survey of the national situation. A speaker representing each section of the country summarized briefly conditions in the group of states in his section under the following heads: (1) Approximate mileage and expenditures for construction in 1919; (2) Conditions as to prices and supply of labor and materials in 1919; (3) Actual new or proposed new state legislation of especial interest; (4) state or county bond issues past or pending; (5) proposed mileage of construction and probable expenditures in 1920; (6) anticipated conditions as to prices and supply of labor and materials in 1920.

On Monday afternoon Professor Arthur H. Blanchard, of the University of Michigan, spoke of the necessity for proper co-operation between adjoining states in order to keep down the cost of materials and construction.

C. M. Babcock, Minnesota, led the discussion on methods of administration. He emphasized that organization is a means to an end, not an end in itself.

A. N. Johnson, Chicago, chairman of the Committee on Salaries of Engineers in Public Service, of the American Association of Engineers, presented the schedule of salaries proposed by the association for highway engineering service. All who discussed the schedule agreed that salaries should be improved in order that good work may be accomplished.

On Monday evening representatives of the Associated General Contractors of America discussed relations between state departments and the contractors and presented suggestions regarding the possibilities of contractors with large organizations taking up highway work.

A resolutions committee was appointed as follows: Charles M. Upham, Delaware; Herbert Nunn, Oregon; W. O. Hotchkiss, Wisconsin; W. F. Cocke, Virginia; George E. Johnson, Nebraska. The following nomination committee was appointed: W. D. Uhler, Pennsylvania; C. M. Babcock, Minnesota; Chas. A. Browne, Florida; T. J. Ehrhart, Colorado; N. D. Darlington, California.

On Tuesday morning the problems of surveys, plans and designing were discussed. In the afternoon Clifford Older, chief highway engineer of Illinois, spoke on the design of highway bridges. Watson G. Clark, New Jersey, and F. E. Elliott, New Hampshire, spoke on the development of local sources of highway materials. H. S. Mattimore, Pennsylvania, discussed the relations between engineers and contractors, particularly the matters of prices, specifications, inspection and fair treatment.

Wednesday was mainly taken up with the subject of the distribution of Federal supplies and equipment and the relations of the various states with the Federal bureau.

On Thursday such subjects were discussed as contract bonds and a national program of highway research.

American Association of Engineers.

On January 2 the Chicago Chapter of the American Association of Engineers elected the following officers for the year 1920: W. J. H. Strong, president; W. H. Dean, 1st vice-president; A. M. Cornell, 2nd vice-president; C. L. Currier, 3rd vice-president; T. A. Dungan, 4th vice-president; J. D. Hoban, secretary; and L. D. Lea, treasurer.

The American Association of Engineers has appointed a committee on the salaries of engineers in teaching service, of which C. J. Tilden, professor of engineering mechanics at Yale University, is chairman. The other members of the sub-committee are being selected.

One of the means which will be employed by the American Association of Engineers to promote engineering publicity throughout the United States is through a co-operative arrangement with the producer of several moving picture weeklies. Arrangements have been made with the producers of six screen weeklies whereby the Association will furnish lists of engineering projects and works, photographs of which will interest the public. After the film people have been notified of some engineering structure or event of sufficient interest they will communicate with their corespondent living nearest the scene of the work or event and he will either take stills or 100 or so feet of film, as the situation merits.

In order to make this project successful the Association will require the active assistance of every professional engineer. Officials of corporations or construction companies who are doing or having done construction work or who are building or installing unusual or otherwise interesting types of machinery, engineers in charge of construction work or who are developing new methods, or who know of spectacular or otherwise interesting features in which the public will be interested, can make this service a success by advising the "Profesional Engineer" of such projects as will warrant photographing.

Commercial engineering publications and society publications are requested to give this as wide a distribution among their readers as is possible in the interest of a greater publicity for the engineering profession. According to the association, "There has never been a time when the general public was so interested in mechanical and other engineering pictures. The time is propitious for developing in the mind of the American public a greater apreciation of the part which the engineer plays in society. An appreciation of the works of the engineer through photographs and moving pictures will not only supplement the publicity which is being obtained locally by the 100 chapters and clubs of the association, but will pave the way for a higher class of publicity which can be developed later."

The association asks of all engineers, "Do you know of any construction work, say of a large dam or bridge, or power plant or industrial works, or blast furnace, or cotton mill which would be of sufficient interest to attract the attention of the general public? Do you know of a new process which has appealing scientific features and which can be photographed readily? Do you know of any particular employment or welfare features employed by industrial engineers, managers or superintendents? Do you know of a survey which is to be attended by physical hardship or actual danger? Is there a building in your town which failed today because it was not designed or constructed under proper engineering supervision? Has your county or your state recently spent an enormous sum for highways? If it has, have the results been worthy of photographing? If you can answer any of these questions or any similar questions in the affirmative send a post-card or brief letter or telegram to the "Professional Engineer," advising the location of the work, and give a brief description of its purpose with the approximate cost or other particular features which make it worth photographing. If the location is out of the usual course of travel, tell how the photographer can reach the work. Your letter need not be long. Just outline the essentials as mentioned and you will be doing the profession a great service. Although the publicity committees of the chapters and clubs of the American Association of Engineers can be of great service in this matter, this appeal is not made wholly to the members of the American Associations of Engineers. Other engineers, public officials, corporation officials, and others who are acquainted with engineering features of interest to the public are earnestly requesfed to render whatever assistance they are able in this development of engineering publicity."

American Water Works Association.

The nominating committee of the American Water Works Association, met at Indianapolis, Ind., December 20, 1919.

The nominations of the committee are: for president, Beekman C. Little, Rochester, N. Y.; vice president, Edward Bartow, Urbana, Ill.; treasurer, J. Walter Ackerman, Auburn, N. Y.; trustees, 2nd district, Harry F. Huy, Buffalo, N. Y.; 5th district, Robert J. Harding, San Antonio, Texas.

District No. 2 consists of the state of New York. District No. 5 consists of District of Columbia, state of Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia. Florida, Alabama, Mississippi, Missouri, Tennessee, Kentucky, Arkansas, Louisiana, Kansas, Oklahoma and Texas.

In accordance with the constitution (Article VI, Section 4) additional nominations for any office may be made "At any time prior to noon on the first day of March by request to the Secretary, signed by at least twenty-five Active, Honorary or Corporate members," the names so nominated to be put on the final ballot, following those nominated by the nominating committee in alphabetical order.

Petitions should be sent to the office of the secretary, J. M. Diven, 153 West 71st street, New York, N. Y.

American Road Builders' Convention Show.

The Seventeenth Convention and Show will open at 2.30 p. m., Monday, February 9th, at the Jefferson County Armory, Louisville, Ky. Governor Morrow of Kentucky will give the opening address of welcome.

Following the Governor's address, Mayor Geo. Weissinger Smith will welcome the delegates in behalf of the city. President G. P. Coleman will respond for the association.

Papers under the general head, "Design and Construction of Different Types of Pavements" will be presented on Tuesday, February 10th, at both the morning and afternoon sessions. The topics to be taken under consideration in the morning are "Concrete Pavements" and "Brick Pavements." In the afternoon papers on "Bituminous Macadam," "Bituminous Concrete" and "Surface Treated Macadam and Gravel" will be delivered. Following each paper will be discussions on the subject, in which all members of the Congress are invited to participate. Motion pictures showing various methods of road construction will be exhibited in the evening.

Both the morning and afternoon sessions of Wednesday, February 11, will be given to the presentation and discussion of papers and reports of committees.

The report of the Committee on "Method of Strengthening and Reconstructing Highway Bridges for Heavy Motor Traffic" will be given on Thursday morning, February 12, followed by the presentation of technical papers. A paper on "Factors which will limit Highway Construction During the Coming Season" and the report of the Committee on "Regulations Covering Speed, Weight and Dimensions of Motor Trucks" will be presented at the afternoon session. In the evening, motion pictures will be shown illustrating the various phases of road construction and maintenance.

Friday, February 13, will be devoted to the presentation of papers and reports dealing with technical problems in road building. Many leaders in road building circles will discuss problems which they have met in their experiences and tell how they overcame difficulties. Discussions will follow and this exchange of ideas will have great educational value.

Invitations have been sent by Governor Morrow to all the governors of the several states and Canadian provinces, and by Mayor Smith to all the mayors of the cities, requesting that delegates be sent to the convention. The number of replies received signify that the attendance of state and municipal officials will be unusually great and that this convention will be the largest of any yet held.

It is reported that the State Legislature is contemplating adjourning for a day to attend the convention in a body. At the headquarters of the association applications for space at the Good Roads Show held in conjunction with the convention indicated that the 50,000 square feet available for exhibition purposes will be inadequate. Manufacturers, it is said, are fully awake to the importance of this event and are showing great zeal in placing their goods before the men who will direct the expenditure of over a billion dollars in road work during the coming year.

The Association subscription dinner at the Hotel Seelbach, Monday evening, at 7 o'clock. Tickets, $4.00 each. Stag and absolutely informal; business suits only; no speech making; elaborate vaudeville entertainment furnished by the people of Louisville.

The Association reception and ball at the Hotel Seelbach at 9 o'clock Wednesday evening, strictly formal. This will be the big social event of the convention. Invitations obtainable at Convention Headquarters.

The good people of Louisville have planned a series of entertainments for the ladies. This will include a matinee, an automobile ride, a card party, a shopping tour, etc.

New Jersey State Association of County Engineers.

At the annual meeting of the N. J. State Association of County Engineers, held at the Engineers' Club at Trenton on Tuesday, January 20, 1920, the following papers were read: "A Method of Numbering Highway Bridges," by Harry F. Harris, County Engineer of Mercer County; "The Attitude of the Board of Commerce and Navigation on Reconstructing Bridges Over Navigable Streams," by J. J. Albertson, County Engineer of Camden County; "Needed Reforms in Highway Work," by James Logan, County Engineer of Burlington County.

The following officers were elected for the ensuing year: President, Thomas J. Wasser, County Engineer of Hudson County; vice-president, A. H. Nelson, County Engineer of Atlantic County; secretary, Harry F. Harris, County Engineer of Mercer County, and treasurer, Alvin B. Fox, County Engineer of Middlesex County.

National Electric Light Association.

President R. H. Ballard of the National Electric Light Association reports that Frank M. Kerr, vice-president and general manager of the Montana Power Co., has accepted the chairmanship of the Committee on Steam Railroad Electrification. The Montana Power Co., of which Mr. Kerr is the operating executive, is now furnishing the power supply for the operation of 657 miles of track of the Chicago. Milwaukee & St. Paul Railroad in Montana and the Pacific Northwest, and consequently Mr. Kerr is in a position to speak with authority on the subject of railroad electrification from a practical standpoint. R. Beeuwkes, electrical engineer of the Chicago, Milwaukee & St. Paul Railroad, will act with Mr. Kerr on this committee, and the additional members will be from other power companies, manufacturers and banking institutions, so that every phase of this great subject will be intelligently handled in the report of the committee which will be submitted at the Pasadena, Cal., convention, May 18 to 21.

M. S. Sloan, president of the Brooklyn Edison Co., Brooklyn, N. Y., has accepted the appointment by President Ballard as chairman of the Committee on Electrical Resources of the Nation. Mr. Sloan is organizing a committee to handle this great subject representative of all branches of the industry. The committee's report to be represented at the next annual convention will be in the nature of a textbook of particular assistance to the small companies throughout the country. The present status of electrical development in the United States, both private and municipal, will be noted, and the comparisons, drawn between different sections of the country and between private and municipal operation, should prove to be very interesting.

Advertising for the Engineer.

Wm. J. H. Strong, president of the Chicago Chapter of the American Association of Engineers, delivered an address at the annual dinner of the Indiana Engineering Society on Friday evening, January 23, in Indianapolis. The subject of his talk was "Advertising for the Engineer."

PERSONAL.

Kelly, John R., has become mayor of Muncie, Ind., succeeding Rollin H. Bunch.

Grace, John P., was recently elected mayor of Charleston, S. C.

Miller, Winton L., has resigned his position as city manager of Bethlehem, Pa. He was formerly secretary to city manager Waite, of Dayton, and later city manager of St. Augustine, Fla.

Wilder, Henry L., who has been superintendent of state highways in Lebanon county, Pennsylvania, since 1912, has received notice of his promotion to the office of township engineer, district No. 10, of the bureau of township highways. Mr. Wilder in his new work has charge of highways in the counties of Lehanon, Schuylkill, Northampton, Carbon, Berks and Lehigh, in as far as state money is used in construction of township or county roads and highways.

PROBLEMS CITIES ARE STUDYING
WITH EXPERTS

Batesville, Ark., is having plans prepared by the consulting engineering firm, W. R. Heagler & Sons, for PAVING IMPROVEMENTS on about nine miles of street.

A new WATER WORKS SYSTEM is to be built by the city of Paragould, Ark., plans for which are being prepared by the consulting engineering firm, W. R. Heagler & Sons, who will also supervise the construction.

PAVING IMPROVEMENTS are to be made by the city of Hartshorne, Okla., preliminary plans for which are being prepared by the consulting engineers, the V. V. Long Engineering Co.

Moweaqua, Ill., is planning SEWERAGE IMPROVEMENTS involving a disposal plant and sewerage system. Preliminary plans are being prepared by the consulting engineers, Miller, Holbrook & Warren.

East Hartford, Conn., has advertised for bids for extensive WATER WORKS IMPROVEMENTS, including two covered concrete reservoirs, a low dam, pipe line, etc. The consulting engineer is James H. Fuertes.

Kenosha, Wis., has advertised for bids for the construction of a reinforced concrete bascule BRIDGE over the harbor. The consulting engineers are the Strauss Bascule Bridge Co.

Goldsboro, N. C., has advertised for bids for STREET PAVING IMPROVEMENTS, covering about 100,000 square yards of pavement, 55,000 lineal feet combined concrete curb and gutter 5,000 square yards of sidewalk paving, etc. The consulting engineer is J. L Ludlow.

Girard, Kans., is to improve WATERWORKS SYSTEM to cost about 44,000, according to plans prepared by the consulting engineers, W. B. Rollins & Co.

The city of Enid, Okla., is soon to let contract for WATER WORKS IMPROVEMENTS, involving 100,000 feet cf cast iron pipe, etc. The consulting engineers are Black & Veatch.

Altus, Okla., voted $45,000 bonds for WATER WORKS IMPROVEMENTS. The consulting engineers are Johnson & Benham.

PAVING IMPROVEMENTS are to be made by the city of Ada, Okla., to cost $350,000, involving 65 blocks. Plans are being prepared by the consulting engineers, Johnson & Benham.

Collinsville, Okla., is having plans prepared by the consulting engineers, Johnson & Benham, for PAVING IMPROVEMENTS, involving twenty-five blocks of brick or concrete pavement, to cost $125,000.

Nowata, Okla., will soon let contract for PAVING IMPROVEMENTS in various strets, according to plans prepared by the consulting engineers, Archer & Stevens.

Canton, O., has retained R. Winthrop Pratt, consulting engineer, to prepare plans and supervise the construction of a WATER IMPROVEMENT project to cost $1,280,000.

Hill County, Hillsboro, Tex., is to spend $2,500,00 on ROAD IMPROVEMENTS. The consulting engineers are Bryant & Huffman.

A hydro-electric commission has been appointed in South Dakota under an act of the legislature, for the purpose of investigating the WATER-POWER RESOURCES of the Missouri River in that state. This commission has engaged Daniel W. Mead and Charles V. Seastone, consulting engineers, to investigate and report.

WATER WORKS IMPROVEMENTS, including water purification plant, pumping station and transmission line, will be made by the city of Pryor Creek, Okla., acording to plans prepared by the consulting engineers, V. V. Long & Co.

Marlow, Okla., is having final plans prepared by the consulting engineers, V. V. Long & Co., for PAVING IMPROVEMENTS.

ROAD IMPROVEMENTS are to be made by the city of Bartlesville, Okla., for which the state highway commissioner will call for bids later. The consulting engineers are Elston & Witten.

Comanche, Okla., is to make PAVING IMPROVEMENTS, involving twenty blocks, for which plans are under way. The consulting engineers are H. G. Olmsted & Co.

Lake Benton, Minn., will make SEWERAGE IMPROVEMENTS, involving 12 to 42-inch storm sewers in various streets, to cost $75,000. Plans are being prepared by the Bradley Engineering Service.

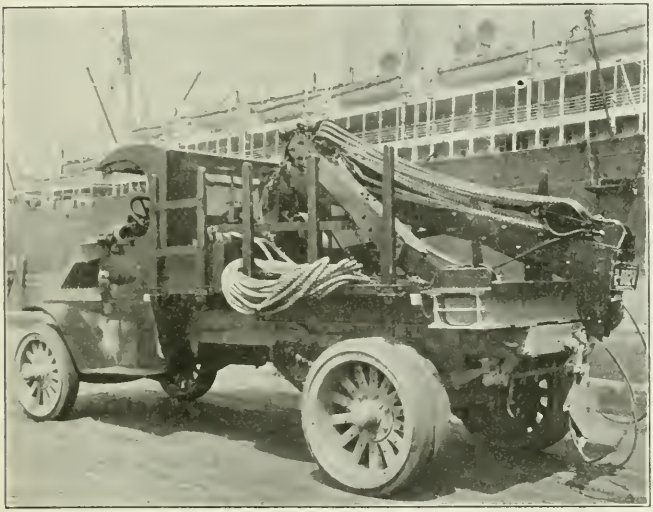
Madelia, Minn., will make PAVING IMPROVEMENTS to cost $100,000, according to plans being prepared by the consulting engineers, the Bradley Engineering Service.

Winnipeg, Manitoba, contemplates $1,000,000 of provincial government DRAINAGE CONSTRUCTION WORK. J. G. Sullivan, MacIntyre building, engineer.

Twin Falls, Idaho, plans the erection of a SUSPENSION OR CANTILEVER BRIDGE across Snake river, canyon at Shoshone Falls, to cost about $350,000. Mr. Murray, engineer.

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.



Wrecking Truck with Derrick Frame Rigged with Hoist Tackle and Lowered for Transportation.

Mack Wrecking Truck

A Mack 7½-ton service wrecker similar to the ones used by the fire departments in New York, Boston, Cleveland, Baltimore and other large cities, has been delivered to the West India Oil Company, Havana, Cuba. It is equipped with a Meade-Morrison horizontal drum winch and collapsible derrick. The derrick is removable and the truck body may be used to haul merchandise.

In use, the derrick extends back over the rear of the truck, is capable of lifting the heaviest trucks bodily from the ground, and can tow disabled trucks on either front or rear wheels by raising the other end clear of the ground. Under the rear of the body platform are two I-beams to support the weight of the derrick. Between the I-beams are two heavy 8 by 10-inch wood blocks, which, when the derrick is in use, rest on the ground and thus relieve the springs.

Motor Plows Remove Snow in Chicago

Here is a fleet of seven Mack motor snow plows operated by the Bureau of Streets in Chicago. Their speed adapts them for removing the snow while it is falling. The plows are demountably attached to the trucks which have dump bodies that can be utilized the year round. On each plowshare is inscribed "Help Keep the City Clean."

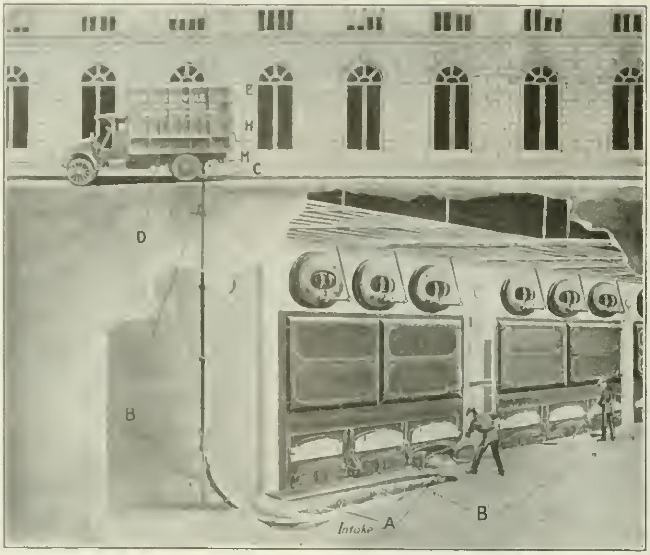
The judicious use of economical, efficient automobile snow plows wherever city streets are obstructed by heavy snow fall will be a substantial help to the fuller utilization of the expensive highways for continuous service.

Pneumatic Ash Conveyor

A new method for the economical and sanitary removal of ashes from basement and cellar boilers, by pneumatic operations, to a movable hoisting plant in the street, discharges them without producing any nuisance, to dump carts which convey them to the points of disposal. This system allows the hoisting apparatus to remain in continuous operation at one point or to be moved independently from point to point as served by one or more dump trucks with a minimum of delay and labor.

The ashes are raked as usual from under the boilers into a 3x3-foot concrete ash pit A, extending across the face of the boilers and covered with removable sectional floor plates. In the bottom of the ash pit there are located intakes into the 8-inch pneumatic pipe B-B′ that is carried up to a point just below the sidewalk, where

Chicago Municipal Motor Trucks Equipped With Demountable Snow Plows.



Pneumatic Ash Hoist and Conveyor Installed in Basement.

it can be attached by a flexible connection M, to the conveyor truck D, which is provided with a high-pressure blower driven by the truck motor, a washing device for removing dust before the ashes are discharged, a silencer, and a steel bin or separator E, which latter forms the body of the truck.

In operation the ashes are allowed to accumulate as long as desired and when the conveyor truck arrives and is connected to the pneumatic pipe below the sidewalk, an assistant in the boiler room attends to the feeding in the ash box while the operator controls the machinery and the ashes and foreign materials which may be mixed with them are hoisted, dampened and discharged to the dump truck through gates M, operated by a rack and pinion driven by a hand crank shaft.

The apparatus up to the sidewalk level, is sold outright, guaranteed, and for a small annual sum is maintained for 10 years and the ashes are removed by the owners of the conveyor and trucks at a fixed rate per cubic yard based on a percentage of ash resulting from a given quantity of coal consumed, as shown by the coal bill or boiler room log.

The present charge for ash removal in New York City is 90 cents per cubic yard, equivalent to about 7½ cents per can. Typical installations can be seen at the Palace Theatre, Hotel Lorraine, the Garford Building and other places in New York City.

The advantages claimed are low cost of installation of the apparatus, saving in labor, boiler room space, elevator installation and maintenance, and the elimination of dust, dirt, noise, fire risk, and dangerous sidewalk openings. It is also noted that at an estimated cost of $6.00 each, and an average life of 6 months, the expense of 3⅓ cents per cubic yard for ordinary ash cans is eliminated. The manufacturers of this apparatus state that the cost of removal of ashes in New York City by the other methods ordinarily employed will run as high as 7½ cents per can.

INDUSTRIAL NEWS

Waterworks Equipment Needed in Trinidad Towns.

According to advices from Consul Henry D. Baker, Trinidad, British West Indies, the mayor of Port of Spain, the capital and largest town of Trinidad, in his annual report to the town council, mentions that it is desirable to install more powerful pumps and build a reservoir holding 4,000,000 gallons, the water to be distributed through the city by gravitation after filtration. He also mentioned that plans had already been prepared by the city engineer for additional water supply for the eastern part of Port of Spain, which include the following features, at an estimated cost of $14,000:

(1) A circular reservoir to deal with water supply of the East Dry or Laventille River, to be constructed of reinforced concrete, 50 feet in diameter and 10 feet in effective depth, containing 120,000 gallons (about two days' supply for the entire district), to be erected on a site near the eastern boundary of the city on land selected by the city engineer.

(2) A four-stage centrifugal pump capable of delivering 10,000 gallons per hour against a head of 200 feet, to be driven by a 25-horsepower electric motor, the pump to be placed on the lands of the present Laventille Reservoir, from which the water to fill the new reservoir will be taken.

(3) A pumping main, about 3,000 feet in length, connected with the new pumping plant as well as with the existing 12-inch main feeding the Laventille Reservoir.

The town council has appropriated the $14,000 necessary for the East Dry River increase of water supply. Correspondence of any American manufacturers who might be interested should be addressed direct to the City Engineer, Port of Spain, Trinidad, British West Indies.

The Legislative Council of Trinidad has appropriated the amount of $83,769 for additional waterworks and improvements to existing waterworks for the towns of St. Joseph and Tunapuna, about 8 to 10 miles from the municipality of Port of Spain; and also the amount of $40,000 for waterworks, supplying water from the Arima River, for the town of Arima, about 20 miles from Port of Spain. Correspondence of American manufacturers who might be interested should be in English with the Director of Public Works, Trinidad Government, Port of Spain, Trinidad.

The Blaw-Knox Company.

A. A. Olstad, formerly connected with the New York office, has been made manager of the New England territory, with offices in the Little Bldg., Boston, Massachusetts, succeeding A. W. Ransome, who has been appointed manager of the Pacific Coast territory, with offices in the Monadnock Building at San Francisco.

A. W. Ransome, formerly manager of the New England territory, with offices at Boston, Massachusetts, has been transferred to San Francisco in the capacity of manager of the Pacific Coast territory with offices in the Monadnock Building, San Francisco.

Mr. Ransome was born in San Francisco, and is a graduate of the University of California, Class of 1897. He played fullback on the university eleven for four years, captaining the team of 1896. Immediately after leaving college, Mr. Ransome became engaged in construction work and in the construction machinery business until 1917 when he became associated with the Blaw-Knox Company.

Westinghouse Man Gets Promotion.

An announcement is made by the Westinghouse Electric & Manufacturing Company that R. A. Neal has been appointed as manager of their switch section, succeeding F. A. McDowell, now manager of the newly created cost and development section.

Mr. Neal came to the Westinghouse company shortly after his graduation from New Hampshire State College, in 1910, and has served in the varoius capaciteis of order man, inquiry man and assistant manager of the switchboard section.

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"
Vol. 48 NEW YORK, FEBRUARY 14, 1920 No. 5

Flood Control Work in the Miami Conservancy District

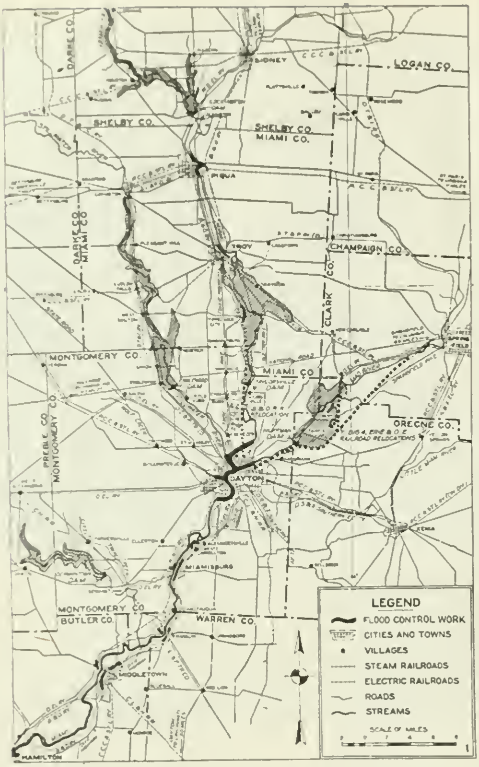
Heavy loss of life and property by the 1913 flood in the Miami valley necessitated the expenditure of many millions of dollars to prevent future disasters. State legislation authorized investigations, financing, administration and the design and construction of great dams and appurtenances and river and road improvements requiring the installation of a million dollars' worth of heavy contractors' plant and equipment, the provision and distribution of eight thousand electric horsepower for making hydraulic and dragline excavations, and the construction of eight million yards of embankment and nearly two hundred thousand yards of concrete. Improved specifications were developed and comfortable provisions made for maintenance and transportation of many hundred workmen.

Some of the most interesting construction methods employed in this work will be described in future articles. This one describes the general plan and the preparatory work.

To prevent recurrence of the devastating flood of 1913, which cost 400 lives and $100,000,000, there are now being executed in the Miami valley, Ohio, about $25,000,000 of engineering construction work, designed, after notably careful study and elaborate investigations and experiments, to control future floods and protect life and property. Part of the flood waters will be temporarily impounded in retarding basins formed by the construction of five large earth dams with open outlets that restrict the maximum flow through the improved river channels.

These dams will contain more than 8,000,000 yards

Incomplete Concrete Conduits Through Germantown Dam Flooded Without Damage.



Location of Dams and Retarding Basins in Miami Valley.

of earth and 183,000 yards of concrete. They are being built by a combination of dumping and hydraulic fill processes, using millions of yards of material, much of which is excavated by enormous dragline machines operated by electricity, about 8,000 h.p. of which is provided and distributed for general construction purposes. More than a millions dollars' worth of plant and equipment have been installed and the heavy work is in an advanced stage of construction under the direction of thoroughly organized engineering and construction forces.

CONDITIONS.

The Miami river and its tributaries drain 5,430 square miles of a well populated, cultivated valley 120 miles long, in the southwestern part of Ohio, where the annual rainfall is about 36½ inches. The river channel slopes about 4 feet to the mile, and in consequence of the severe storm of March, 1913, it became the outlet for a flow of 250,000 second-feet of flood water that inundated wide areas of the valley, submerged some of the city streets to a depth of several feet, caused the loss of 400 lives and damaged Dayton, Piqua and other towns and villages and the adjacent country to an estimated amount of $60,000,000 to $150,000,000.

LEGISLATION AND ORGANIZATION.

In order to consolidate and perfect the flood protection operations of the different localities, the state of Ohio passed the Conservation Law, creating the Miami Conservancy District, composed of nine counties affected by the improvements. Each county is represented by its judge in a Conservancy Court, and three directors were appointed with executive powers. They retained experts who made a thorough investigation and recommendations, directed the preparation and execution of a protection system and also appointed appraisers to evaluate the damage and benefits resulting from the improvements. The directors issued bonds to provide funds for the execution of work by force account and by contracts awarded by the directors and engineers.

The Board of Directors is composed of Edward A. Deeds, president, Henry M. Allen, Gordon S. Rentschler, and Ezra M. Kuhns, secretary. Arthur E. Morgan is chief engineer, Charles H. Paul, assistant chief engineer, C. H. Locher, construction manager, and Oren Britt Brown, attorney. The headquarter's offices are located in Dayton.

Extensive surveys were made, records examined, measurements taken and flood prevention systems in other places were thoroughly investigated. After an exhaustive study of the problem, it was concluded that its best solution would be obtained by the establishment, in different portions of the valley, of basins that would temporarily impound the flood waters and, by retarding their flow through the improved river channels, would to a considerable degree equalize the volume of water and diminish its maximum depth there, at the same time that the inundated areas would be greatly restricted or eliminated.

CHARACTER OF WORKS.

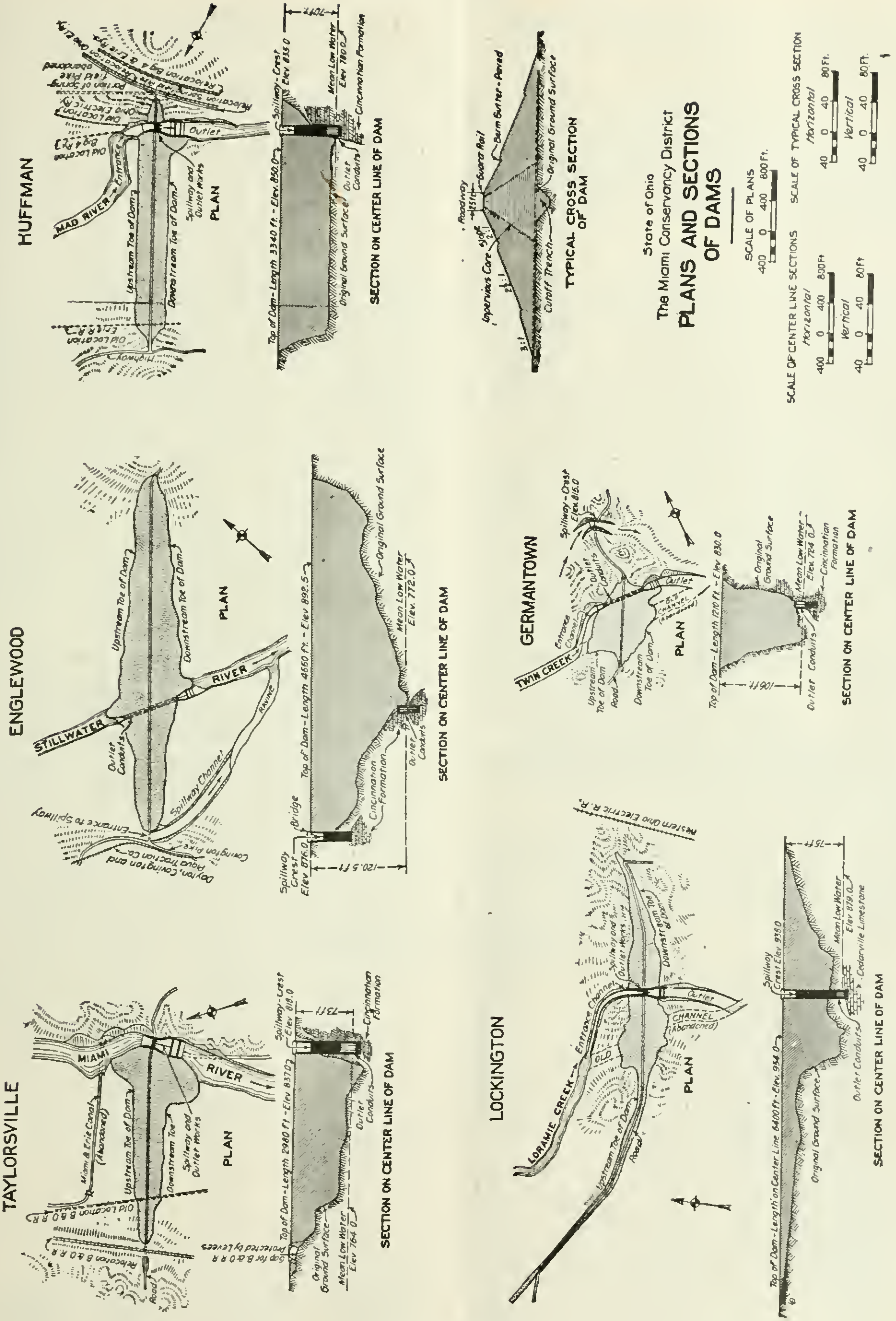
The system includes the construction of five great earth dams and their concrete overflows, sluices, conduits and other appurtenances; the protection of river banks and bottom with riprap, deepening, widening and straightening the channels; the relocation of many miles of steam and electric railway tracks and highways formerly located below the flood line of the retardation basins; the execution of considerable temporary and auxiliary work, and the provision of camps, shops, storage facilities and distribution and transportation appliances.

The improvements are designed to give protection from a flood twice as great as that of 1913, and to provide for the harmless run off, in three days, of a possible rainfall of 10 inches over the whole drainage area. For a flood of the same magnitude as that of 1913, it is estimated that the effect of the four dams above Dayton would be to reduce the flow of the river at that point from 250,000 second-feet to 100,000 second-feet.

IMPOUNDING DAMS.

The five great dams and their retarding basins, the latter having a combined area of 290,800 acres that will be submerged by a flood equal to that of 1913, would in such an event temporarily store 621,000 acre-feet of water. They are located one on each of the principle streams of the valley, namely the Miami, Stillwater and Mad rivers and on Lorraine and Twin creeks.

The most suitable sites for the dams were determined by topographical and geological surveys, by subterranean explorations made with systematic borings that



Plans, Elevations and Cross Sections of the Great Earth Dams with Concrete Spillways and Conduits.

produced samples of the underlying strata, and by the location and testing of local materials for earthy embankments and concrete aggregate.

Each of the dams is located with one end and the spillway and conduit supported on ledge rock, and is provided with a concrete center core wall, spillway, and outlet. All are of the same gravity type and similar proportion illustrated by the accompanying cross section diagram, and where they are founded on porous material, the latter is protected by a 4-foot blanket of impervious material.

CONTROL OUTLETS.

The normal flows of the streams are provided for by the conduits and outlets through the lower parts of the dams which permit the low water flows to pass unobstructed down the channels. When the flow becomes sufficiently greater than normal, the surplus water backs up above the top of the outlet and is temporarily impounded in the retarding basin until it begins to flow over the spillway weir at an elevation of about 15 feet below the crest of the dam.

DESIGN OF OUTLET.

In times of flood, the velocity of discharge through a conduit may increase to 60 feet per second, necessitating very careful design of the outlets to enable them to safely endure the great hydraulic forces.

Original investigations of the flow through the outlets were largely possible through the generosity of Colonel E. A. Deeds, president of the Board of Directors. A large-scale model of one of the conduits was constructed, tests were made and experiments conducted in the hydraulic laboratory established on Colonel Deed's estate. They resulted in the adoption of a type of outlet fitted to absorb the mechanical energy of the water by the principle of the hydraulic jump. The outlets were designed with a flaring basin and with high side walls and a floor descending by steps to a pair of baffle walls or weirs.

SPECIFICATIONS.

A notable feature of the specifications is the attempt to emphasize the principle that they apply to two honorable contracting parties and are intended to conserve the rights and obligations of both without involving unjust or unnecessary obligations upon the contractor. A form of bond was adopted that is designed to provide full protection to the District without imposing upon the securities any unreasonable obligations.

The specifications are divided into three separate parts, of which the first two, relating to general conditions and to general requirements, are applicable to all work and are supplemented by the third part, detail specifications, that, with the agreement, estimate, and drawings, outline in detail how each kind of work shall be done and measured for payment. The general conditions govern the relations of the contractor, to the district, to the public and to his employes. The general specifications define and classify the principal materials and the method of executing the work.

A special system of index numbers and letters make very simple provision for reference and classification. The different items of construction work and materials are designated by serial numbers and any specification section referring to them is designated by its numeral followed by a decimal point, after which the item number is written so as to positively and briefly indicate the required information. These specifications for items were published in one volume for the five dams and in another volume for the channel improvement projects at Dayton and Hamilton, but the same numbers are applied to given items whether they occur in the channel improvements or in the dams or in both; and when followed by the letter A, refer to work located below the low water datum as indicated on the drawings.

INFORMATION FOR BIDDERS.

Before inviting bids on the construction work, there was sent to prospective bidders a pamphlet entitled "Information for Bidders," which contained the most complete data that could be secured in reference to conditions likely to be encountered, together with a list of proposed contracts, directions for preparing the bids, information regarding local supplies and material, laws, public service conveniences and statements of quantities.

Special effort was made to encourage local bidders of moderate or limited resources, by dividing the work into a large number of separate contracts which, however, were susceptible of combination so that they could

Dimensions of Dams and Appurtenances.

—	Germantown Dam	Englewood Dam	Lockington Dam	Taylorsville Dam	Hoffman Dam
Drainage areas above dam, sq. miles	270	651	255	1 133	671
Maximum height above valley floor	100	110.5	69	67	65
Average elevation bed of river	723	770	876	759	777
Average drainage valley floor	730	782	885	770	785
Elevation of spillway crest	815	876	938	818	835
Elevation of top of dam	830	892.5	954	837	850
Maximum elevation of water surface for a flood like 1913	805	862	936	9 650	7 300
Area submerged in a flood like 1913, acres	2 950	6 350	3 600	9 650	7 300
Maximum amount of water stored in a flood 1913, acre-feet	73 000	209 000	63 000	152 000	124 000
Maximum average depth of water in reservoir in a flood like 1913, feet	24.8	32.9	17.4	15.7	17.1
Length of crest of dam, feet	1 210	*4 716	*6 40	*2 980	*3 340
Thickness of dam at average elevation of valley floor, feet	650	739	410	390	380
Length of outlet conduit, feet	546	709	45	40	40
Number of conduits	2	2	2	4	3
Total sectional area of outlet conduits, souare feet	182	217	158	1 116	705
Maximum discharge of conduits in 1913 flood, second-feet	9 340	11 000	8 630	51 300	32 600
Length of spillway crest, feet	55	100	72	132	100
Vertical diameter of conduits (temporary), feet	22 ft. 10 in.	22 ft. 6 in.	......	......	......
Vertical diameter of conduits (permanent), feet	9 ft. 1 in.	10 ft. 5⅜ in.	9 ft. 2 in.	19 ft. 2 in.	16 ft. 4in.
Maximum width of conduits	13 ft.	13 ft.	9 ft.	15 ft.	15 ft.
Yardage of earth in dams	790 000	3 550 000	1 032 000	1 131 000	1 547 000
Yardage of concrete in dams and appurtenances	20 000	38 000	38 000	47 000	40 000

* Including spillway crest.

also be executed in large units by contractors with adequate organizations and equipment.

The advertisement especially noted that the larger contracts contained numerous smaller items of work that might be sublet, and the chief engineer of the district invited communications from sub-contractors wishing to get in touch with the large contractors. The unusual political, military and industrial conditions prevailing at the time the work was commenced were such that but few bids were submitted, and only one, a proposal for levee work, was accepted.

CONSERVATION DISTRICT CAMPS.

As all of the five great dams, employing many hundreds of workmen in their construction, are situated in sparsely populated districts at considerable distance from large towns and without sufficient means for passenger transportation, it was necessary for the district to provide at each dam site a camp, which, after serving the construction forces for several months or years, is intended to have a permanent value. Topographical studies were made by an expert in city planning who laid out villages, each provided with cottages, a school house, stores, mess hall, just-aid station, and a community hall.

Available existing buildings, like large barns or tobacco sheds, were remodelled for bunk houses arranged with long corridors between the sleeping rooms, each of which has a double deck steel cot and an outside window. These are occupied by the single men who are charged 50 cents per week or, if they occupy separate rooms, are charged 75 cents and $1.00 per week. Meals are served at the camp mess for 35 cents each. The cottages, which have from three to five rooms, rent for $13.00 and $21.00 per month, and, like the bunk houses, are all equipped with shower baths. Where the work is of a more temporary nature so that the camps were not established and there were not sufficient local accommodations and transportation facilities, the men and materials are transported from headquarters by 54 District automobiles including eleven large Ford and Hudson touring cars, thirteen Ford light delivery trucks, four Ford runabouts, 8 Ford one-ton trucks, five Ford depot wagons, 7 Pierce-Arrow five-ton trucks and five Pierce-Arrow two-ton trucks.

All employes are treated solely in accordance with their character and workmanship and their right to organize is recognized. At each camp there is established a system of local self-government to which all camp members are eligible and by which all matters of local interest in connection with the general welfare are decided by a modified commission-manager form of organization.

An extended description of some of the important features of the service work is given in a paper by H. S. R. McCurdy, division engineer, which was presented to the New England Water Works Association at the convention last September, from which the accompanying diagrams are reproduced.

The Virginia Good Roads Association is making a drive to increase the membership to 5,000 paying annual dues of $2 each. It will employ a paid secretary and issue a monthly bulletin. Committees are assigned to enlist membership and steps have already been taken toward amending the state constitution so that bonds may be issued for the construction of highways. An educational campaign will also be carried on to instruct voters on the advisability of constructing good roads promptly.

City Planning

George H. Nye, city engineer of New Bedford, Mass., recently addressed the municipal section of prominent engineering societies on City Planning and Development, illustrating his remarks with views shown of changes made to relieve congestion in the centre of New Bedford.

Mr. Nye pointed out that his subject covers a wide range of topics, including the arrangement and construction of streets, sewerage and drainage systems, water supply and distribution, traffic regulation, lighting, schools, public buildings, civic centres and housing zoning.

Attempts to improve city planning service give rise in many cities, to a subdivision of work among boards, resulting in much waste of effort and lack of co-ordination. More recently, in a few cities, these matters have been placed in the hands of city managers. In Massachusetts these officials have no administrative authority; they simply advise. Under this system the tendency too often is to recommend changes that prove too radical.

Municipal engineers should be given more authority. "If the engineer is a man of vision, with the interest of the city at heart, he will plan consistently for all improvements which can best be reviewed and carried out by the elected officers of the city," he said.

It is estimated that in Decatur, Ia., the cost of paving in 1920 will be 20 per cent greater than for similar work done in 1919.

Cost Plus Contract for Ohio Road

A committee of the Ohio Legislature has filed a report stating that the cost of 1½ mile of brick, Highway No. 1, in Guernsey County, was $80,000, and that the time required for its completion was 1 year 28 days. The original contract having been canceled on account of war conditions, the completion of the work was done on force account plus a 10 per cent commission, plus rental for equipment and payment for teams. The report states that the force account contractor expended money recklessly and it condemns the cancellation of the original contracts under which $300,000 was paid for the completion of 11½ miles of road.

Governor Smith, in a message to the Legislature of the state of New York has recommended the immediate release of the ten million dollar balance of the second fifty million dollar bond issue for construction of highways, which is urgently needed to provide funds for the continued road construction planned for 1920.

After six years of litigation in an effort to widen a 500-foot block on South Salina street, Syracuse, the court has rendered decision in two cases, one of which permits the widening of one end of the block and the other prohibits widening at the other end of the block, thus rendering the proposed improvements impracticable.

Investigation of the proposed vehicular tunnel between New York City and New Jersey indicates that it will cost perhaps thirty million dollars.

Repairing a Damaged Reservoir

An English reservoir, located between two coal mines, was damaged by the settling of the ground over these mines, a crack 1⅛ inches wide crossing the entire reservoir. This was repaired by uncovering the bottom rock and placing over the crack in it a slab of reinforced concrete encased in a sheet of asphalt, on top of which was relaid the original bottom lining.

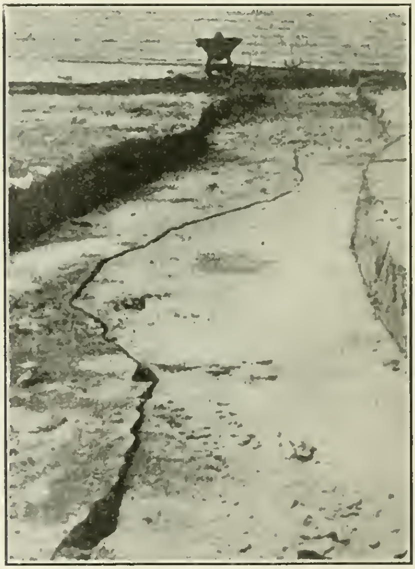
The Downhill reservoir, belonging to the Sunderland and South Shields Water Company, was constructed in 1899 with a length of 220 feet, breadth of 150 feet and depth of 17 feet from floor to top of coping, with a total capacity of 3,000,000 gallons. The walls were of stone masonry. The floor construction consisted of 12 inches of concrete on the limestone rock (which had previously been leveled off), covered with 18 inches of clay puddle. Both of these extended under the wall, the puddle under the wall being mixed with gravel. Over the clay puddle was laid a floor of cement concrete flags 2½ inches thick, the joints between which were run with cement grout; a thin bed of sand being placed between the puddle and the flags. The floor was divided longitudinally by eight 10x16-inch concrete curbs to facilitate cleansing.

The reservoir is situated between two coal workings, which were 1,770 feet below the surface at this point. The damage to the reservoir to be described was apparently due to a slight settling over each of these workings which caused a longitudinal motion in the two directions, resulting in a crack or parting in the rock at the site of the reservoir.

In June, 1916, a joint in the coping was observed to have opened about a quarter of an inch and later a crack of the same width was traced down the wall and across the floor, with a slight crack in the opposite wall. Plugs were put in the masonry to permit measuring the movement. This was very small however until July, 1917. At this date it was found that fissures had opened also in the fields southwest of the reservoir. There was very little if any additional movement until March, 1918. On March 21st the company received a telephone message to the effect that the floor of the reservoir had suddenly given way and the whole of the water escaped. It was found that the crack entirely across the reservoir had increased to a uniform width of 1⅛ inches, the crack extending through the walls, puddle and concrete flooring. The crack was also found extending to the east and west of the reservoir. With the rushing out of the water, a considerable amount of clay puddle had been washed down into the fissure and allowed several patches of the floor flagging to fall into the depression.

The method adopted for repairing the reservoir was affected by the consideration that it was probable that coal would continue to be drawn from the area on either side and that consequently further movement might take place. Such movement would probably be not in the nature of a true subsidence but rather a lateral movement which would tend to open the cracks still further. It was therefore decided to attempt to repair the floor by use of a sheet of bituminous material and a reinforced concrete mat in such a manner that, even if further movement of a similar character should occur, the reservoir would remain water-tight.

After removing the concrete flags and the puddle from both sides of the break, the crack was found to extend through the underlying concrete, and this was cut out to a width of three feet on either side of the crack and down to the limestone rock. The rock also was excavated to a further depth of about 9 inches, the bottom of the cut being given a V shape. This channel in the rock was then filled with concrete which was brought up level with the general surface of the rock and the whole was given a smooth surface by means of cement mortar. Sheets of bituminous material were then laid in the channel in the concrete reservoir bottom, the sheets being lapped and jointed and the edges left standing up sufficient to allow of six inches being turned over on top of the reinforced concrete mat. This mat was then placed, being made eight inches thick and reinforced with expanded metal of 3-inch mesh with ample lap at the joints. After this mat had set, a layer of bituminous sheeting was laid over the whole of its upper surface and the edges of the bottom sheeting were turned down and joined on to this top bituminous sheeting. The fissure was thus bridged with a slab of reinforced concrete which was entirely encased in bituminous sheeting and rested on a smooth surface. At the ends of the concrete mat the bituminous sheeting was turned up and the ends cemented in to a chase cut in the stone wall.



Crack in Rock in Reservoir Bottom.

This mat was covered with concrete brought up to the level of the original concrete floor, except that a gap two feet wide was left in the concrete directly over the fissure; the idea being that a certain amount of sliding might take place between the reinforced concrete mat and the rock beneath it and at the same time between the mat and the concrete floor above it, in which case the gap in the concrete flooring, which was filled with clay puddle, would provide a more or less elastic joint between the two halves of the reservoir floor. Puddle and concrete flags were then replaced as in the original construction.

The cracks in the walls were pointed up on the front and back faces and were then run full of cement grout. To permit this, shafts were sunk at the backs of the walls down to the concrete foundation, and it was found that the cracks in the backs of the walls in each case corresponded exactly to those in the front. After the pointing in the cracks had set, the cracks were washed out thoroughly with clean water and cement grout poured in. A tub full of grout was mixed at a time so that a constant stream could be poured into the crack until it was filled. Grout containing 9 bags of cement was poured into the west wall and 7½ bags into the east wall.

The rock under the foundations of the west wall at the point of fracture was found to be so badly broken that it was necessary to drift through underneath the wall and bridge over the fissure by means of short lengths of steel beams embedded in the concrete, the gravel puddle being replaced between this and the bottom of the wall and rammed thoroughly into position before the grouting was begun.

The author expressed the opinion that if service reservoirs must be constructed in districts subject to surface damage due to mining operation, it is very much safer to locate them on ground from under which the whole of the coal is to be withdrawn than upon that over or in the vicinity of barriers which are not to be worked out. In the first case, subsidence may take place without serious damage being sustained; but in the latter case, when damage is caused it is almost certain to be of a serious nature and to extend over a considerable period of time.

We presume that the same danger of rending apart of the foundation rock might occur in the case of large quarrying operations on one or both sides of a hill on which a reservoir is located.

Fighting Water Shortage in Norfolk

It having been reported that there was a shortage of water in Norfolk, Va., which threatened the fire protection of the city, the National Board of Fire Underwriters investigated the conditions on January 15th. The result of the investigation is given in a bulletin of the board which has just been issued, the conclusion being that "the situation in regard to fire protection cannot be considered critical, so long as the present precautions are continued."

The city obtains its water supply from lakes having a normal storage of about 2,000 million gallons, but due to the abnormally low rain-fall of 1918 the storage has been lowered to 300 million gallons. The water department has installed electric or gasoline-driven centrifugal pumps at various points so as to be able to utilize all of the water in the various lakes. It is estimated that between 5,000,000 and 8,000,000 gallons a day of ground water is reaching the lakes. In extreme emergency salt water could be pumped into the lakes.

LIMITING CONSUMPTION.

The normal daily consumption of the city is about 12 million gallons and the normal pressure about 50 pounds. On December 4th, in an effort to decrease consumption, the policy was adopted of reducing the pressure to 8 pounds from 10 p. m. to 6 a. m.; to 20 pounds from 6 to 7 a. m. and from 5.30 to 6 p. m.; 12 pounds from 8.30 a. m. to noon, from 1 to 5.30 p. m. and from 8 to 10 p. m.; and 40 pounds from 7 to 8 a. m., from noon to 1 p. m. and from 6 to 8 p. m. The city is practically level and probably in no part would the pressure fall below 8 pounds. The pumping station receives all alarms of fire on a gong over a fire alarm circuit and a telephone also is provided. On first alarms, additional pumps are primed if necessary, and on second alarms or special calls the pressure is immediately increased to 45 pounds. The result of lowering the pressure has been a decrease in consumption to about 7,000,000 gallons a day.

The water has a slightly brackish taste at present and, although tests show it to be safe, it is objected to for domestic purposes and the city is hauling water in tanks and sprinkling carts from private supplies and distributing it to those who wish it.

EMERGENCY MEASURES.

Work has been started on an emergency connection with the Berkeley supply. A 14-inch submerged main crosses the river from Portsmouth to Berkeley and from the terminus of this line a 16-inch main is being laid to the bridge leading to Norfolk, from which point a 20-inch pipe will be laid to Water and Main streets. Two 2,225,000-gallon electrically operated pumps are installed at the terminus of the 14-inch line. From 2,000,000 to 3,000,000 gallons a day will be available from this source.

It is also planned to start work at once on a nine-mile line of 20-inch main laid on the surface of the ground to Lake Drummond, through which to obtain a temporary supply of 8,000,000 gallons a day, which line it is expected to have in service by the middle of April.

On February 17th a bond issue of $6,000,000 for a new supply will be voted on, plans for which supply are now being made. These plans include laying a 36-inch line to Lakes Phillips and Burnt Mills, 18 miles away. A reservoir will be built at the lakes with an average depth of 12 feet and a capacity of 3,100 million gallons. These lakes will give a supply of 15 million gallons a day, with further development possible. This water will be pumped into the distribution system at a point opposite where the present supply enters.

As additional present precaution, the fire department has made a careful investigation of the docks along the water front and has located 24 points where pumping engines can take suction. The fire captains have been instructed as to these locations and the owners of property at these points have been ordered to keep the docks and roadways to them open. On first alarms along or near the water front, all motor pumps respond, the steamers being called later if needed.

The engineer of the board, Robert C. Dennett, reports that the city officials are doing everything that can reasonably be expected to maintain adequate fire protection. While the pressure throughout the city is below normal most of the day, enough water for a first stream is available at any hydrant and, with the electric pumps in service, additional pressure can be obtained in two or three minutes, so that "as long as the means of transmitting alarms to the station are in service and are promptly utilized when necessary for increasing the pressure, the situation in regard to fire protection cannot be considered critical."

Electric and Gas Engine Pumping at Milltown

By Samuel Speirs.*

Both types of engines installed at the outset and both used, electric regularly and gas for emergencies. The author describes the operating costs and the various features of each kind of service.

The pumping station of the municipal water works, of Milltown, N. J., affords an interesting chance to compare the merits of electric-motor driven water pumps and gas-engine pumps.

Installed in a one-story brick building 30 x 26 feet, which cost $2,240, are two complete pumping units of the same capacity (350 gallons per minute), consisting of two Deane triplex 10 x 10 inch plunger pumps; one driven by a Wagner 30 h.p. 2-phase motor and the other driven by an Ingego 30 h.p. 1-cylinder, 4-cycle gas engine. The electric-motor driven pump consumes in one hour 17.5 k.w.h. at $.025 per k.w.h., which is $.437 per hour. The gas-engine driven pump consumes in one hour 550 feet of gas at $1.15 per 1,000 feet, which is $.6325 per hour.

Electric Motor—The electric motor is equipped with an automatic start and stop apparatus actuated by a pressure coil which is very sensitive and invariably stops the motor when the water in the standpipe is within two feet of the top. The gas engine can have no attachment like this.

It is our practice to have a man call at the station at eight o'clock in the morning to change pressure-recording chart, record gallons pumped, oil and grease the pump, and then start the motor by hand, wait until motor comes up to speed and all three cylinders are primed, and then leave the pump to take care of itself. The whole operation takes but 15 minutes but counting the time used going and getting back to regular place of work, one-half hour is gone. At four o'clock in the afternoon he visits the station again, throws in the starter and again leaves, making a total for labor of one hour a day.

The reason for starting by hand is that by so doing we keep off the night load and thereby keep down the maximum demand, with the resultant reduction in the rate paid per k.w.h., as we purchase our current from the Public Service Corporation of New Jersey on their well-known wholesale power plan. The automatic starter will operate upon the opening of a fire hydrant, which is a great advantage for plants where an engineer is not always on duty.

Gas Engine—The gas engine is equipped with an air compressor and storage tank by which the starting of the engine is but little more work than starting the motor. But as it has not been deemed advisable to go away and leave the gas engine running without attention, as it has no automatic stop, and we are pumping a daily average of 84,000 gallons at 350 gallons a minute, it would be necessary for a man to stay at station four hours daily in addition to the one hour used for starting, changing charts, etc., making five hours labor daily to be charged against the gas engine, in comparison to one hour daily for the electric pump.

The gas engine and pump were originally installed as an emergency unit in case of failure of electric current or breakdown of the electric motor pump, and was so used on two occasions in January, 1918, when the electric current was taken off by the Public Service Corporation on account of the shortage of coal. It is also used occasionally to keep it in condition.

As to noise, the gas engine is the more quiet in the station, due to the fact there is but one gear reduction while on the electric motor pump there are two. But as the exhaust is outside the building and discharges into the atmosphere it can be heard for a considerable distance, while the electric motor pump cannot be heard 200 feet from the building. Cooling water must of course be run continuously while the gas engine is run.

The space occupied by gas engine is 16 x 10 feet and by electric outfit 8 x 10 feet. First cost for furnishing in place with foundation and appurtenances for gas engine and pump was $2,930, and for electric motor and pump, $2,480.

The gas pump has pumped 1,000,000 gallons and the electric-motor pump has pumped 73,000,000 gallons and has been in operation since May, 1915, and during that time there has been absolutely no repair to gas engine or pump, and to the electric motor pump one gauge glass costing eighty cents has been broken.

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* Superintendent of Water Department, Milltown, N. J.

In case of fire it is possible to run both units at once, thereby increasing the gallons per minute; and by closing the valve at the standpipe we can increase our pressure from an average of 60 pounds to 100 pounds. On account of the labor cost and the difference in fuel cost we rely on our electric-motor pump to do our regular pumping, and fall back on our gas-engine pump in emergencies.

This plant was designed and built under the supervision of Clyde Potts, of New York City.

Scavenging Privy Vaults

Machine cleaning was tested by engineers of the Public Health Service, who found it much cheaper, less offensive and more sanitary than hand cleaning. The figures of the test are given.

In a considerable number of cities in the southern states sewers are found in only a few streets or not at all. The serious danger of typhoid epidemics from open privies has led the Public Health Service to conduct a campaign for minimizing this danger by the construction of tight concrete vaults, protected from access by flies by a superimposed structure thoroughly screened. This involves a method of periodically cleaning the vaults in a cheap as well as sanitary and inoffensive way, which the ordinary hand cleaning is not.

Recently tests were made at Fayetteville, N. C., of the scavenging of such vaults (removing their contents) by means of a portable pumping outfit such as is used for cleaning catch-basins, this test being conducted at the request of the Public Health Service and under its supervision. The machine used was furnished by the Springfield Engineering Company, and we are giving herewith the official figures through the courtesy of that company. Judging from this test, the engineers of the Health Service concluded that with this machine vaults can be scavenged at a fraction of the cost of hand work, with lack of ordor, without leaking or splashing and in a sanitary way.

The machine used consisted of a 1,200-gallon tight steel tank, with a centrifugal pump, mounted on a 5-ton motor truck chassis. The pump is driven by the truck motor, draws water from the tank and, forcing it through a jet opening in the intake line, creates a vacuum in the suction hose. For breaking up solid material a jet of water under pressure up to 120 pounds can be used for reaching the vaults.

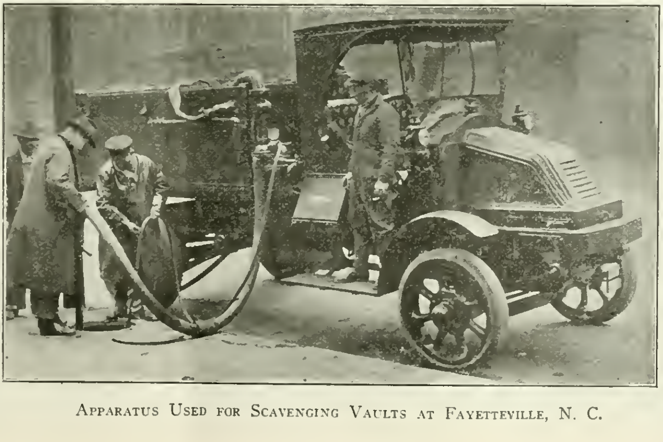
Eight vaults of 110 gallons capacity each, six of which were full and two partly full, were scavenged in 22½ minutes. Four vaults were reached from one position of the machine, and the other four from another position, one minute being required to move the machine. In order to determine the time necessary for dumping, this load, with the tank not yet completely filled, was dumped into a sewer manhole. Returning from dumping, the machine scavenged five more vaults, three of which were completely filled with very thick, unctuous and gumbo-like material, in 20 minutes, including a short stop to take on water. This gave an average time per vault of 3.2 minutes, or 4.2 minutes per filled vault, for scavenging only.

The trip to the dump three-quarters of a mile away, dumping, and returning required 40 minutes over rather poor roads. The test began at 3 p. m., scavenging the thirteenth vault ended at 4.32 p. m., and dumping the second load was completed at 5.00

The actual time of scavenging full vaults varied from 30 seconds, where the content was very liquid, to 5 or 6 minutes where it was quite solid or full of rags, chips, etc.

The engineers estimated that with water-tight vaults, installed convenient to alleys or other passageways, with scavenging routes laid out for economical service and dumping stations near the ends of routes, the time required would not exceed 1 minute for laying suction pipe and water line, 5 minutes average time for cleaning vault, 1 minute for picking up suction and water lines, and 3 minutes for moving machine to next vault; a total of 10 minutes. Where more than one vault or compartment can be reached from a single position of the machine, the time would be corresponding less. Allowing 40 minutes for dumping a load containing the contents of 8 vaults, 32 vaults could be cleaned in an 8-hour day.

Given a cost of machine of $7,500 with 6 per cent interest and 20 per cent depreciation, $500 a year insurance, $60 license, $300 maintenance, $600 annual overhaul, driver at $5 and two helpers at $4 each, and $300 for garage rental, the daily fixed charge for 300 working days would be $25.37. The mileage charges, on a basis of 50 engine-miles a day, are figured $4 for gasoline and oil; and on a basis of 20 miles travel, the tire charges are $1. This gives a total operating cost of $30.37. At only 32 vaults a day this gives a cost per vault of less than $1. At three cleanings a year this give a cost for scavenging of about $3 a year.



Apparatus Used for Scavenging Vaults at Fayetteville, N. C.

Municipal Co-operation in Hydro-Electric Power

Ontario municipalities co-operate in producing and distributing current through the Hydro-Electric Power Commission, each municipality operating its own distribution system. In 1918 166 municipalities served 183,357 customers in this way. Cost and income figures are given.

Throughout a considerable area of the province of Ontario, Canada, the municipalities obtain current from central hydro-electric plants which are operated on a co-operative basis under the control of the Hydro-Electric Power Commission of the province. The report of this commission for the year ending October 31, 1918, has recently been published.

The cities obtain current from a number of plants, 117 of them from the Niagara system, 16 from the Severn system, 5 from the Wasdell's system, 19 from the Eugenia system, 5 from the St. Lawrence system, 1 from the Thunder Bay system and 3 from the Muskoka system. The report contains itemized accounts of the transactions of the several systems and also of the several municipalities, showing the results of the co-operative operation of the plants and municipal distribution of the current. Periodical inspections were made of the accounts of each of the muncipalities, the local officers being assisted by the commission in the installation and use of improved methods of office routine. In the smaller towns and villages, where the utility was in charge of men with little or no bookkeeping experience, the accounting was in many cases done by the members of the municipal auditing staff of the commission.

EARNINGS AND COST.

A system of monthly balance sheets and quarterly operating reports enabled the provincial commission to keep in close touch with local conditions. The capital expenditures and operating expenses were periodically divided into the principal revenue accounts, lighting, commercial power, municipal power and street lighting, and these in turn were set against the respective revenues for the purpose of rate adjustment and service cost. This enabled the commission to authorize and enforce a schedule of selling rates in each municipality so that each of the above-named revenue departments would be self-supporting, and excessively high rates in one were not made to balance a deficit in another.

The percentage of net debt to plant cost for the year showed a decrease from 75.5 per cent to 71.0 per cent. Of the 166 municipalities reported, the revenue in 124 was sufficient to take care of all operating and fixed charges and depreciation; in 26 others the fixed charges and part depreciation were met, and in only 16 was there an actual loss. The gross loss in the 16 last named totaled $15,635, of which $7,798 was due to the abnormal cost of operating a steam plant by one city where but a limited amount of hydro-electric power was available; and $3,964 was due to the operation, in two of the other cities, of local plants before transmitted power was available. The total accumulated deficit of all of the municipalities up to the end of 1918 was $27,884, while the accumulated surplus and reserves was $7,805,473. At the end of the year the system was serving 183,357 customers and a population of approximately 1,205,000.

The rate per horse-power collected from the municipalities varied widely. The lowest rate was at Niagara Falls, $11.50, while $14 was charged in four different municipalities. The price ranged from this to $69.34 in one municipality.

FIGURES CONCERNING MUNICIPALITIES

The number of municipalities obtaining current in this way increased from 28 in 1912 to 166 in 1918. The total earnings in the former year were $1,617,674, and in the latter year were $7,082,039. In 1918 the surplus was $1,136,860 and the depreciation charge was $718,162. The total assets in the plant property were $22,352,951, in addition to which there was $26,941,248 in bank balance, inventories, sinking funds and other assets. The total liabilities were $19,143,775.

The municipalities were of a very wide range of population, 37 having less than 500 population, the majority of the others being below 10,000, while Ottawa had 100,561 population, Hamilton 104,491 and Toronto 460,526.

In the Niagara system (by far the largest) the total costs for the year for power furnished to municipalities were as follows: Power, $1,137,263; operating, maintenance and administration expenses, $335,082; interest, $411,570; total, $1,883,915. The average horse-power furnished to all the municipalities was 128,711 and the total revenue from municipalities was $2,451,661. In addition, there was furnished to companies 28,118 average horsepower, the total expenses of which service were $370,422 and the total revenue $483,547. In several instances the balance at the end of the year showed a deficit in the accounting between the system and individual municipalities, these deficits totaling $27,642; but the total of the surpluses was $265,951.

RATES CHARGED.

The lighting rates charged by the several municipalities varied to a greater or less extent. For the domestic rate a uniform charge of 3 cents per hundred square feet was made by all municipalities, and for the first three kw. h. per hundred square feet the prices varied from 2 cents to 10 cents per kw. h., and all additional varied from 1 cent to 10 cents. Commercial rates varied from 4 cents to 18 cents for the first thirty hours, from 1.2 to 10 cents for the next seventy hours, and from 0.15 to 10 cents for all additional. There was a uniform discount of 10 per cent for prompt payment in all municipalities except one, where a 20 per cent discount was allowed.

Fate gasoline locomotives have been extensively used and have given satisfactory service on the flood prevention work in Miami Conservancy District, where 3-ton locomotives on 3-ft. service tracks have been employed for hauling concrete from the mixers to the great dams, core walls, conduits, culverts, bridges and other construction now in progress in the district, much of which has been mentioned from time to time in these columns.

One of the locomotives has developed a record efficiency of 198 cu. yd. of concrete hauled in one day. The locomotives, although not operated by skilled mechanics, are stated to have been remarkably economical in their consumption of fuel and lubricants.

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Come Early and Avoid the H. C. L.

A statement from the Delaware State Highway Department that contract bids in response to invitations issued late in the season were in some cases 15 per cent. higher than earlier ones for similar work emphasizes the economy of preparedness for construction.

When road work and paving are determined on, plans, specifications, estimates and contracts should be prepared in complete readiness for the letting, the invitations issued early, plenty of time given bidders, and the awards made promptly.

Engineers and other city officials should co-operate for quick, thorough action. Standard work, under known conditions, and with more pay looks so good to a winter-bound contractor, that he will often hurry to make a low bid that he would scorn a few weeks later when things open up.

Besides the effect of the dull season and the opportunity to make thorough preparations that minimize cost, prices of plant and materials are likely to be at a lower ebb than later and deliveries much easier and safer. Now is the time, it is a public duty to save dollars by saving days.

High Class Mountain Highway Construction

The construction in the outskirts of the New York Metropolitan district of a short length of very costly and difficult highway now in progress, is a notable example of up-to-date policy and improvements of commercial and scenic lines and a commendable object lesson in conquering physical difficulties. The location of this road, 400 feet above the adjacent river, along almost vertical rock cliffs and precipitous slopes, where the material was treacherous and no paths existed, made it exceedingly difficult and costly to install heavy plant and equipment ordinarily used for such work or to deliver the necessary supplies and materials.

The difficulties were materially increased by the danger of jeopardizing traffic on the parallel railroad immediately below the highway, and by the exposure to very severe weather conditions that limited the construction operations. These features resulted in an unusual combination of methods by which the grading and building were simultaneously attacked at several different points where careful and costly hand work was supplemented by such mechanical aid as could be made available. Rocks were carefully broken and deposited in safe places, large quantities of treacherous material were removed to prevent the possibility of land slides, explosives were cautiously used, surveyors and drillers alike worked with safety lines, while drills and hoisting engines were operated by air pressure carried up the mountain side where coal could scarcely be transported, and plans and estimates were made for cableways, gravity inclines to replace mule tracks, and pack trails over which machinery and supplies were at first delivered.

The wise and liberal character of the management is especially indicated by the unusual flexibility authorized in location and construction that permit the line to be shifted as conditions are disclosed that make it possible to avoid difficulty or diminish cost by immaterial deflections. Much experience has been gained and improved methods have been developed in the four years of progress since the work was commenced, and it is a matter of satisfaction that the work suspended by the cancellation of the original contract has been resumed under a second contract awarded to the same contractor who has the advantage of great familiarity with the site and requirements, has trained his employees to efficiency under the unusual conditions, and is able to select and install the most desirable equipment, thus executing the work in accord with high standards, unusual experience and engineering supervision thoroughly familiar with the difficult problem.

Unionizing Municipal Engineers

In view of the fact that quite a number of engineers in municipal employ in this country have joined unions affiliated with the A. F. of L. and near-unions, the following from the English "Municipal Engineering & Sanitary Record" referring to similar action in that country is of interest.

"We have had to refer in our columns during the last two years to the indifferent treatment meted out by Irish County Councils to their chief and assistant surveyors. The salaries paid them are often as meagre as £120 a year, out of which they have to pay their own traveling expenses. These councils yielded in a very undignified manner to applications for increases of their laborers' wages when made through the secretary of their Laborer's Union. Recently the assistant surveyors and clerks in the offices of the Galway County Council applied for the enforcement of the civil service award in connection with their salaries, but the application was turned down. These officers have, as a consequence, been driven into the Irish Workers' Clerical Union, which body lost little time in telegraphing the clerk to the County Council that a strike of the officials would commence as from Saturday, the 20th ult. Inasmuch as all the clerks are involved, it means that expenditure entailed in the upkeep of the roads, the asylums, workhouses, and hospitals, the payment of doctors, nurses, and staffs, and of workmen on the roads would be suspended, whilst the supervision of the latter would be entirely withdrawn. The county surveyor deemed it imperative, we understand, to lock out the whole of the workmen—over 900 in number—and the administration of the county, we are told, is at a standstill. Whilst we should prefer that disputes between local authorities and their professional and indoor staffs were settled without recourse to strikes, it appears that the attitude of some authorities leaves such staffs without any alternative.

"Corporations and county and district councils in England have also given way almost every time a demand has been made on behalf of the out-door employes through their trade unions for increases of wages. This may or may not have been politic on the part of these authorities, but it has had the effect of strengthening trade unionism, of whetting the appetites of the laborers for more, and of causing serious discontent among the professional staffs and clerical workers. The councils, it must be recognized, play their cards with very indifferent judgment. To give way with extraordinary alacrity to demands made by trade unions, and when the professional and indoor workers—who have not yet got their union—apply for increase of salaries such applications are turned down in a very unceremonious manner, is in our opinion, singularly myopic. It is an incentive to grave discontent, for laborers' wages are often increased to a figure higher than that of the brain workers. Officials well know that local authorities would rarely refuse with such scant courtesy their reasonable applications for increases if, like the laborers they were fortified by a trade union. Such authorities are consequently encouraging, through their erroneous and short-sighted policy, the spread of trade unionism."

Demand for Engineers Increases Salaries

The following review of present conditions throughout the country as to demand for engineers and salaries being paid them has been prepared by the American Association of Engineers and made public under date of January 30th.

Resumption of activities in the engineering field as viewed by the service department of A. A. E. has come quickly in various quarters where a year-end pause had been witnessed, and existing conditions differ sharply from those of last year when hesitation was nearly everywhere manifest. This condition is bringing about a situation of acute demand for technical service, which it is safe to say is without precedent. In order that contracts can be completed or even started, and in order that the enormous amount of necessary designs for new construction for enlargements of many existing plants and for maintenance of plants now in operation to cope with the present day industrial expansion, the lack and urgent need of professional engineers is extremely serious.

It is this situation, which is as evident in the West and South as in the East, that is gaining for the technical engineer that just recognition not only in point of remuneration but for the professional services which he renders. Never before has there been such a predominance of favorable features for the engineer. The demand is greater than the supply can hope to equal. This is making it necessary for the employer to resort in outbidding his competitors in order to increase his staff. As a result remuneration for technical engineers is through necessity increased in most quarters.

The greatest demand at present is for experienced designers and draftsmen on structural steel and reinforced concrete. Many calls are received for architectural draftsmen mostly for industrial work. A great amount of construction work will be started soon which will result in the need for many engineers of construction experience, who, during the winter months, have in many cases been working along other lines. Engineers of mechanical and electrical experience are in demand, particularly graduates who are competent in theoretical calculations. There is a great need for editorial men and instructors in our engineering institution. Also research, promotional, and production engineers.

From a wide variety of sources covering the entire country, the average salaries paid the engineers are as follows: Tracers, $125 per month; detailers, structural, mechanical, and electrical, $175 to $200, a few companies paying up to $225 per month for experienced men; designers on all classes of work, $250 a month and up; estimators and checkers, $300 per month; rodmen and levelmen, $125 to $150 a month; instrumentmen, $175 to $200 a month; assistant engineers, $200 and up per month; map draftsmen, $200 a month; surveyors, $175 a month; research engineers, $275 per month and up. The salaries of engineers who have reached the executive class depends entirely upon the specific organizations with which they are connected. The salaries of production engineers, chief draftsmen, chief engineers, and superintendents of construction range anywhere from $3,000 to $15,000 per annum and more in the large corporations.

The program for the expenditure of almost a billion dollars on highway construction during the current year will result in the need of many engineers for highway work. Information as a result of canvass of state highway engineers indicates that at the most conservative estimate, no less than 5,000 engineers will be needed in 1920 to carry out this program. Appointments are usually made first as junior highway engineers, which salaries range from $175 to $200 a month, depending upon the state. Promotions to positions of greater responsibility in highway departments are usually made through civil service from men already on the staff. However, in a few states appointment to position of resident engineers, assistant engineers, and inspectors are made direct by application.

The Great Outdoors

Civil engineers as a class are lovers of the great outdoors. To many of them, the opportunity which engineering offers to satisfy the longing to be out in the open was an important argument in deciding them to adopt this profession. The editor, on reading the following quotation, found it so eloquently expressing his own feelings that he believes that other engineers will appreciate it also. It appeared in the house publication of the East Iron & Machine Company, which is published under the name of "Eimco," and was as follows:

Get Out In the Open.

"Did you ever notice how many people there are who smother their instinctive love of nature; lead an almost artificial existence and form artificial taste? They take automobile rides in summer, not to enjoy nature, but to create a breeze. They golf only for the game, and are seldom drawn out by the allurements of nature or the exercise to be gotten by a walk in the woods or open. In winter they ride in closed, heated cars and fret about the time spent in getting from radiator to radiator. When the winds begin to howl, and snow settles around in drifts they're afraid to venture out on foot to see winter and feel the rigors of old Jack Frost.

"There are those who really love nature in all its moods and seasons. They tramp over the hills without games to stimulate their interest; enjoying the sweet scented blossoms and green foliage in the springtime and the blizzards of the winter.

Numbering Highway Bridges

A comprehensive system modeled after the Dewey system of cataloguing has been developed for identifying the highway bridges in Mercer County, New Jersey. The numbers indicate township, stream, the main stream of which it is tributary, and the number of bridge counting up said stream from its outlet.

The engineer of Mercer County, New Jersey, Harry F. Harris, in a paper presented before the New Jersey County Engineers Association last January, described a system of numbering the bridges of the county which he had developed. Some such system seemed necessary in order that exact information concerning each bridge might be recorded and all bridges be put and kept up to a standard of strength and condition.

To meet this need with a simple, elastic and comprehensive system, Mr. Harris decided to use a modification of the "Dewey Index System," which he described as follows:

It was first decided to subdivide the county into nine districts, and for convenience the townships were used for this purpose, each district or township being assigned a key number; for instance, all bridges in

Hopewell township begin with.................200
Princeton " " " 300
Ewing " " " 400
Lawrence " " " ....500 etc.

Similarily all bridges in the City of Trenton begin with 100.

As the next step, we gave to each principal stream within the county a key number, which was to follow the district key; that is, all bridges across the Assunpink creek bear the number 4, regardless of the township or district; likewise, if a bridge were across the Millstone river, it would have the number 6, and if across Stoney brook 3. In other words, these numbers all occupy the tens column. Now, should the stream be a principal tributary of the Assunpink or Millstone it would bear, first, the index number of the township; next, the key number for that stream, and the following digit would then indicate whether it was a tributary of that stream. Should the bridge be cross the principal stream itself and not be on a tributary at all, the next figure very logically becomes a cipher.

Thus we have in the first three figures the township, stream and tributary fixed. We then use a period, and the next figure indicates the number of the bridge on the tributary or main stream. That is to say, the numerical arrangement of that bridge itself is taken care of at this point, the numbering commencing at the mouth of the stream or tributary.

To give a concrete example: A bridge bearing the number 541.7 shows, first, that this bridge is in Lawrence township because it is among the 500 series; next, being in the 40 series places it on the Assunpink or a tributary; while the next figure shows that the structure is not bridging the Assunpink direct, but a tributary thereof, and furthermore that it is the first tributary in that township, counting from the mouth of the stream. Now we have arrived at the decimal point. The figure following the point shows the relative position of that bridge to all other bridges on that particular stream.

The question may arise as to how a bridge would be numbered which spans a stream forming the boundary between two townships. This very frequently occurs. We meet this situation by adding one more number in the hundreds, bearing the key number of one of the two townships and separating this from the adjoining township key figure by a dash; thus 6—540.3 shows at once that this is a township line bridge, and at the same time both townships are indicated and the additional information as to stream location.

In order not to complicate the system unduly, it is well not to carry the refinements to extremes. This is particularly true if you attempt to carry the tributary numbering too far. The principal point in favor of the system, however, is the fact that the geographical location of a structure automatically fixes its number. Or conversely, if reference is made in a resolution or a report to bridge No. 740.1, as an example, you immediately are able to locate this on your index map to within a very small area without effort, while if all the bridges in the county were numbered consecutively it might take considerable time to search for its location, especially where the number of bridges might exceed 1,000.

If one desired, the first set of numbers could be omitted altogether, and as an alternative, letters could be substituted for the township keys. For instance the stream key can be prefixed by

Ho. indicating Hopewell Township
P indicating Princeton "
E indicating Ewing "
L indicating Lawrence "
Ha. indicating Hamilton " etc.

This would eliminate the necessity of fixing the key figures in the mind for indicating the townships. This is, however a matter of detail. Each county has its own peculiarities which have to be worked out as separate problems.

To the several advantages which have already been noted, the ease with which new numbers can be inserted or interpolated might be added; also the ease with which the duplication of numbers can be avoided by reason of the fact that each series of numbers is confined to a very small area. As for the disadvantages, these seem to be few. At first sight the system may seem to be considerably complicated, but upon giving it some little study it will be seen that this is not the case. One important disadvantage which might be cited is that of numbering inter-county bridges where several adjoining counties had adopted this system. However, it would seem that by co-operation of the county engineers this could be very readily adjusted.

In this county we propose, after a survey has been completed of all the bridges in the county, to tabulate the information collected by the field corps on a card index system modelled after the system now in use by Mr. McClave of Bergen county. On one side of the card appears information relative to the cost of the bridge, the contractor, date when built and other pertinent data; and on the reverse side a sketch showing the type of bridge, principal dimensions of the bridge structure, etc.

Annual Paving Statistics

Facts and figures from several hundred cities concerning the amount and nature of work done by each during 1919.

The first installment of our Annual Paving Statistics, that is prepared from data secured in general response to a carefully developed questionnaire sent to all municipal paving officials in this country, was published in Public Works, February 7, and contained Tables 1-11, inclusive, that are respectively headed: Sheet Asphalt; Brick Pavement; Granite or Other Stone Block; Miscellaneous Pavements; Concrete Pavement; Bituminous Concrete; Resurfacing Pavements; Tar or Asphalt Macadam; Bitulithic Pavement and Macadam. Table No. 12, Labor and Contracting, was given for Alabama, Arkansas, California, Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan and Minnesota. The balance of this table, for the remaining states, is given herewith and will be followed in succeeding issues by supplementary data.

The first column in Table No. 12 is in answer to the question: "By what percentage was the cost of the different kinds of pavement higher in 1919 than before the war?" The second column, to the question: "About how many unskilled laborers will be available for contract work in 1920, in the city and vicinity?"

TABLE NO. 12—LABOR AND CONTRACTING.

		Common labor				
City and State	Increase in Cost, percentage	Available	Prevailing per hour or day	Price in 1919 hours per day	Kinds of pavement laid by day labor	Kinds of pavement laid by contract
Mississippi						
Canton	....	....	2.50	10	....	....
Missouri						
Bethany	90	50	5.00	10	none	all
Brookfield	50	20	.40	9	none	all
Fulton	....	....	3.00	9	....	....
Kansas City	53-153e	....	4.00	8	....	....
Sedalia	90-100	300	4.00-4.50	10	none	all
St. Charles	....	50	3.15	9	....	....
Montana						
Billings	24	not enough	5.00	8	none	all
Nebraska						
Freemont	35	15-20	.50	9	all	none
Lincoln	50-80f	150	4.50	10	none	all
New Jersey						
Bordentown	....	50	4.50	9	none	all
Bound Brook	81	very few	4.50	9	Tarvia	stone block & brick
Camden	90	not enough	.45	..	asphalt	granite block
Collingswood	92	170	.50	9	none	all
Elizabeth	50	....	4.00	8	none	all
Garfield	35	....	4.50-5.00	8	none	all
Highland Park	....	....	4.50	9	all	none
Millville	100	....	3.00-3.50	8	gravel	....
New Brunswick	83	....	.50	8	none	all
Passaic	41	....	.60	8	none	all
Plainfield	50	not many	4.00	8	bit. macadam	brick & concrete
Summit	75	100	3.00g	8	all	none
Wallington	50	....	4.50-5.00	8	none	all
Westfield	75	25-30	4.75	9	none	all
West Orange	....	plenty	.50	..	10,000 sq. yd. Tarvia penetration	all others
New York						
Albany	60-80	200	4.00	8	none	all
Binghamton	28-43n	50% of normal	4.40	8	none	all
Brooklyn	52-128[l]	....	4.00	8	none	all
Ellenville	....	20	3.00	9	....	....
Elmira	44-57[k]	150	3.60	8	none	all
Fairport	60	100	4.00-4.50	8	none	all
Geneva	105	50	4.00-5.00	8	bit. macadam	brick & concrte
Herkimer	80	....	4.50	9	gravel	reinforced concrete
Little Falls	32	scarce	4.00	8	none	concrete
Mamaroneck	....	....	4.00	8	none	all
Niagara Falls	45	300	4.80	8	repaving	all else
Ogdensburg	....	scarce	2.75-3.00	8	resurfacing	concrete
Olean	40-50	150-200	3.60	8	none	all
Oneida	35	40	4.40	8	none	all
Poughkeepsie	80	....	3.60	8	all	none
Rochester	65	....	4.40	8	none	all
Rome	....	....	.45	..	none	all
Salamanca	98	200	4.50	9	none	all
Schenectady	100	200	4.40	8	none	all
Sidney	75	20	4.50	9	none	all
Watertown	80-100[l]	500	4.00	8	all	none
North Carolina						
Asheville	100	....	2.75	8	Durax	bit. concrete & concrete

TABLE NO. 12—LABOR AND CONTRACTING (Continued).

		Common labor				
City and State	Increase in Cost, percentage	Available	Prevailing per hour or day	Price in 1919 hours per day	Kinds of pavement laid by day labor	Kinds of pavement laid by contract
North Carolina						
Elizabeth City	....	100	3.00	10	....	....
Fayetteville	100	50	3.50	10	none	all
Greensboro	80	very few	3.50	10	none	all
Statesville	....	....	3.00	10	none	all
North Dakota						
Wahpeton	35	....	5.00	10	none	....
Ohio						
Akron	35	....	6.00	10	none	all
Ashland	75	50	4.00	10	none	all
Bucyrus	100	enough	4.00	10	none	concrete
Columbus	100	....	4.00	8	none	all
Conneaut	75	50	.45	8	none	all
Coshocton	100	200	4.50	10	none	all
Delaware	....	100	4.00	10	....	....
East Palestine	100†	none	4.00-5.00	8	none	all
Edgerton	....	....	3.00	9	none	all
Lakewood	85	....	5.20	8	none	all
Lancaster	33	60	3.50	8	none	....
Lima	40	....	.40-.45	10	none	all
Marysville	....	50	4.00	10	....	....
Newark	....	....	.40	8	none	all
Niles	30	none	4.50	8	none	all
Perrysburg	50	....	3.50	9	none	all
Salem	....	40	4.00	8	....	....
Sandusky	....	very few	4.50	9	....	....
Sciotoville	....	40	3.50	10	all	none
Sidney	33	25	.40	9	none	all
Toledo	70	....	.50-.60	..	none	all
Zanesville	103	200	4.05	9	none	all
Oklahoma						
Altus	30	200	5.00	8	none	....
Bartlesville	75-125m	very few	5.00	8	none	all
Oklahoma City	70	....	4.00	8	none	all
Shawnee	60	300	4.00	8	none	....
Wagoner	....	100	4.00	8	....	....
Pennsylvania						
Altoona	230	very few	3.50-5.00	8	none	all
Beaver Falls	75	few	5.00	10	none	all
Berwick	....	100	3.60	9	....	....
Carlisle	....	50	3.50	..	all	none
Clearfield	50	150	4.00	10	all	none
East Bangor	....	....	3.15	9	....	....
Erie	35	200	.50	9-10	none	all
Franklin	....	40	5.00	10	none	all
Freeland	33⅓	25-30	3.30-3.60	9	none	all
Greensburg	....	none	4.50	9	....	brick
Hazleton	50	....	4.20	10	none	all
Lebanon	....	200	.35-.40	10	none	all
Lehighton	....	25	3.50	10	none	....
Media	100	plenty	4.00	8	all	none
Miners Mills	....	....	.35	..	none	all
New Castle	100	100	.42	9	none	all
Norristown	50-67	few antiques	4.05	9	all	....
North Braddock	135	....	4.50	10	none	all
North-East	50	....	.50	..	none	all
Osborn	103	....	.50	9	none	all
Philadelphia	50	....	4.50	9½	none	all
Pittsburgh	60	....	...	..	none	all
Rankin	120	....	4.50	10	none	all
Reading	100	....	3.20	8	none	all
Scranton	50	....	4.50	10	none	all
Shippensburg	50	25	.35	10	all	none
Somerset	82	....	3.50	9	none	all
Swoyersville	60	....	.35	..	none	all
Tyrone	....	40-50	4.00	9	....	....
West Homestead	100	....	4.50	10	none	all
Williamsport	53	....	5.00	10	none	all
Windber	43	....	4.00	9	none	all
Rhode Island						
Pawtucket	33⅓	....	.50-.55	..	bit. macadam	stone block, Endurite & Warrenite
South Carolina						
Clinton	40	20	2.25	10	none	all
Union	100	scarce	2.50	10	all	none
South Dakota						
Aberdeen	....	....	4.50-5.50	10	....	....
Sioux Falls	70	plenty	.50	..	none	all
Tennessee						
Clarksville	....	300	2.50	10	....	....
Dyersburg	....	100	3.00	10	....	....
Greeneville	....	scarce	3.00	10	....	....
Jackson	....	400	3.00	10	gravel	concrete & asphalt
Johnson City	....	50	3.00-3.50	10	....	....
Texas						
Beaumont	....	plenty	.37½-.50	8	none	all
Clarksville	....	400	3.00	8	....	....
Dallas	45	enough	4.00	8	gravel	all others
Gainesville	30	300	3.50	10	....	....
Hillsboro	55	....	3.00	8	....	....
Houston	28	rather scarce	.40-.50	8	none	all
Longview	70	plenty	.35	8	none	all
McKinney	85	50	3.50	8	none	all
San Antonio	50-100	1,000	2.25-2.50	8	all	none
Waxahachie	....	175-250	3.00	8	....	....
Utah						
Logan	....	....	4.00-4.50	8	....	....
Ogden	35	....	4.00	8	none	all
Provo	80	....	3.50	8	part of concrete	part of concrete
Tooelle	....	....	4.00	8	....	....
Vermont						
Middlebury	100	....	2.75	9	all	none
St. Albans	10	50	3.50	9	gravel	tar macadam
Virginia						
Covington	....	75	3.50	10	none	all
Danville	....	....	3.00-3.50	10	....	....

TABLE NO. 12—LABOR AND CONTRACTING—(Continued).

		—Comon labor—				
City and State	Increase in Cost percentage	Available	Prevailing per hour or day	Price in 1919 hours per day	Kinds of pavement laid by day labor	Kinds of pavement laid by contract
Washington						
Aberdeen	50-55	....	5.50	8	none	all
Auburn	100	few	5.20	8	none	all
Bremerton	70-90	100-150	6.00-7.00	8	part of concrete	part of concrete
Charleston	30	enough	5.50	8	none	all
Wisconsin						
Appleton	50	....	.45-.50	8	none	all
Baraboo	33	....	.40	..	none	all
Beloit	70	75	5.00-6.00	10	....	....
Delavan	65	20-30	4.00	10	none	all
De Pere	....	200	4.00-5.00	10	....	....
Eau Claire	....	....	3.75	9	none	all
Edgerton	16	very few	4.50-6.00	10	none	all
Fond du Lac	30-50	shortage	5.00	10	none	all
Grand Rapids	lower	enough	.45†	8	all	none
Kenosha	72	1,000	5.00	9	none	all
Lake Geneva	50	40	3.50-4.50	9	all	none
Madison	23-30n	100	4.50	9	none	all
Manitowoc	100	....	.50-.55	8	....	....
Marinette	....	scarce	4.25	9	all	none
Portage	25	100	3.50	10	all	none
Racine	35	....	8.00	9	none	all
Waukesha	20	very few	4.40	8	none	all
West Milwaukee	50	....	.50-.60	..	....	....
Canada						
Charlottetown, P. E. I.	....	plenty	3.00	9	all	none

USE OF REMOVED MATERIAL

In the questionnaire from which were obtained the data given in the tables on paving, inquiry was made as to the use to which the various cities put any of the material removed in resurfacing. Such material would consist of stone and dirt from macadam pavements, stone and bituminous cement from bituminous macadam or bituminous concrete, bituminous wearing surface from old sheet asphalt, and bricks, stone blocks and wood blocks from those several types of pavements.

It was not learned that any use was made of wood blocks. Stone blocks were either redressed and relaid or were broken up for concrete or macadam. Bricks seem to find quite a variety of uses, several cities using them for building manholes, for backing and rear walls of buildings and other structures, for building sewers, where they would serve nearly as well as new bricks.

In bituminous material the old asphalt or tar has usually lost practically all of the volatile oils and the other constituents which give it "life" and is not suitable for re-use where much reliance is to be placed upon the cementing value of the bitumen. It has been used, however, for a top dressing for macadam pavements in side streets where the traffic is light and where it will frequently give a surface at least as good as, if not somewhat better than, water-bound macadam. In some cases, however, this old bituminous material is merely dumped as filling on low land. The stone and dirt from the tops of old macadam pavements are quite frequently used for constructing new macadam pavements on side streets—about the only places where the use of macadam in cities is justifiable under present traffic conditions.

Expert Urges Water Supply Be Doubled

In Asheville, N. C., following an investigation into the city's water system, covering the North Fork watershed, from which the present supply is obtained, and the Bee Tree watershed, G. Gilbert White, hydraulic engineer of Durham, who has been in Asheville for some time, recommended that immediate steps be taken to construct the 16-inch pipe line to Bee Tree; that surveys be made at once invesigating the feasibility of developing additional water supply from North Fork; he urges that plans be prepared for an available supply of ten million gallons per day, half of which ought to be delivered to the city daily; a suitable site should be found near the city for the erection of a reservoir of not less than 10,000,000 gallons; plans be made to separate the city distribution system into two districts. The increase in the use of water here has jumped 88 per cent between 1910 and 1919, he states and from 1916 to 1919, 51 per cent. He says that the 16-inch pipe from North Fork, which when new would deliver 3.2 million gallons per day, has been diminished by the usual reduction in the carrying capacity of cast iron pipes, caused by roughening of the interior, to 2.8 million gallons when the pipe was ten years old and 2.6 million gallons when 15 years old.

"The inadequacy of the present supply has been shown to be due," he says, "to the limited water shed area as well as to the size of the pipe line; as the first serious shortage was experienced during three weeks of September, 1919, when it was reported that the 16-inch pipe line at its head ran about three-fourths full.

"It is difficult to determine how much water was then flowing through the 16-inch pipe. Having in mind all the circumstances connected with the pipe line, it probably was then carrying not more than 2.0 million gallons. From other data based on rainfall, it appears that the amount of water supplied by the various streams during the dry period of 1919 was probably less than 2.0 million gallons per day, and that this was also true in November, 1917, although not so noticeable then because so much water was not being used."

Jacking a Tunnel Shield

Two miles of 6-ft. tunnel sewer in Milwaukee were recently constructed with a pair of 22,500-lb. steel shields about 9½ feet in diameter and in length. They are each driven forward by ten 60-ton hydraulic jacks operating at a pressure of 5,000 pounds per square inch and reacting against a preliminary circular wooden tunnel lining made up of rings 6 inches long consisting of ten segments each.

The segments are made from 6x6-inch pieces of maple heart timber 34¼ inches long on one side and 30¼ inches long on the other side. The long side is cut to the circumference of the shield circle by a band saw and the two triangular corner pieces removed are fastened to the straight inner side of the segment, with the concave side outwards, thus making the inner sides of the segment practically parallel circular arcs and nearly doubling the end bearings of the radial joints. The pieces thus cut off, of course, are not quite full lengths but are reduced to 13½ inches each, leaving a short tangent between their thin ends at the center of the segment.

The hydraulic jacks react against the wooden segments that distribute and transmit the pressure and are left permanently in position when the tunnel is completed by a lining of unreinforced concrete 6 inches thick.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Damages or Pollution by Sewage Disposal Plant—Noxious Odors.

(S. C.) Evidence in action for damages held to sustain finding that there was no additional pollution by defendant city's sewerage purification plant of the stream flowing through plaintiff's lands.—Sturgis v. City of Rock Hill, 100 S. E. 163.

Evidence in action for damages held to show that defendant city's sewerage purification plant, by purification of a stream nearer plaintiff's land than the plant, decreased, rather than increased, foul smells and noxious odors.—Id.

Licensing of Food Stores—Physical Examination of Proprietor—Power of City.

(Or.) Ordinance of the city of Portland, No. 35013, providing if the location of a food establishment is found to be suitable, and in proper sanitary condition, according to the ordinances of the city and the regulations of the United States as to plumbing, etc., the bureau of health shall issue a food establishment permit or license to the applicant, is definite and certain, though there is no specification of what shall constitute physical fitness in an applicant for license, or suitability in the location.—City of Portland v. Traynor, 183 P. 933.

Under its charter giving the city of Portland power to make regulations to prevent the introduction of contagious diseases, etc., the city had power and authority to adopt its ordinance No. 35013, providing for the licensing of food and soft drink establishments on approval of their location, physical examination of the proprietor, and payment of a fee.—Id.

Laundry as Nuisance—Reasonable Use of Property—"Balance of Injury."

(Ga.) The privilege of use incident to the right of property must not be exercised in an unreasonable manner, so as to unnecessarily injure another.—Holman v. Athens Empire Laundry Co., 100 S. E. 207.

Every one has the right to use his property as he sees fit if in so doing he does not invade the rights of others unreasonably judged by the ordinary standards of life and according to the notions of reasonable men; such right implying a like right in every other person, and being qualified by the doctrine that the use in the first instance must be a reasonable one, the maximum being "Sic utere tuo ut alienum non laedas."—Id. The pollution of the air, so far as reasonably necessary to the enjoyment of life and indispensable to the progress of society, is not actionable.—Id.

Every one has the right to have the air diffused over his premises, whether located in the city or country, in its natural state and free from artificial impurities, which means pure air consistent with the locality and character of the community.—Id.

Smoke is not a nuisance per se, but to be a nuisance it must produce either actual, tangible, and substantial injury to neighboring property itself, or such as to interfere sensibly wih its use and enjoyment by persons of ordinary sensibilities.—Id.

As affecting the jurisdiction of equity to restrain nuisances, there is in principle no distinction between cases of smoke, smell, noise, or gas.—Id.

In cases of nuisances, the foundation for the interference of equity rests in the necessity of preventing irreparable injury and multiplicity of suits.—Id.

The jurisdiction of equity to restrain nuisances is in aid of the legal right, when that is inadequate, and to prevent a multiplicity of suits.—Id.

The doctrine of "de minimis," as relating to injunctive relief, does not apply where the injury is appreciable, causing either actual, tangible, and substantial injury to neighboring property, or interfering sensibly with its use and enjoyment by persons of ordinary sensibilities.—Id.

The doctrine of "balance of injury," as relating to injunctive relief, is applicable in the granting or refusal of interlocutory injunctions to restrain nuisances.—Id.

In a suit to enjoin the continuance of a nuisance created by smoke alone, the plaintiff cannot be denied injunctive relief, where his case is otherwise made out, because it would injure the defendant or the public to grant it, as in such case the chancellor has no discretion at the final trial.—Id.

In a suit to enjoin the continuance of a nuisance created by smoke alone, the injuries may be balanced, and the discretion of the chancellor exercised in the grant or refusal of an interlocutory injunction.—Id.

Municipal Beach Proprietary Function—Liability for Personal Injury.

(Neb.) In absence of statute, a city maintaining a public park and municipal beach therein for bathing, etc., performs a governmental and not a proprietary function, and is not liable for personal injury to one exercising such privileges, resulting from negligence of city officers, notwithstanding an incidental revenue from rental of buildings used in connection therewith.—Caughlan v. City of Omaha, 174 N. W. 220.

Duty of City to Remove Snow From Sidewalks.

(Iowa) No duty rests upon a city to remove snow and ice from sidewalks, so long as they remain unchanged by the interference of man or other artificial cause.—Gregg v. Town of Springville, 174 N. W. 23.

Building Contractor's Factory as Nuisance—Right to Use Highway.

(Mich.) No merchant, manufacturer, or any other person has any right to use any part of highway for deposit, exhibition, or sale of his goods, or to keep goods constantly standing on the walk, or teams constantly or for any considerable portion of the time in front of his premises engaged in loading or unloading goods, notwithstanding necessity of so doing in the course of his business.—Mackenzie v. Frank M. Pauli Co., 174 N. W. 161.

Equity will not prohibit the conduct of a lawful business by a defendant on his own unrestricted premises, except as a last resort to restrain an otherwise unavoidable nuisance existing in violation of a complaining party's right.—Id.

Where building contractor's interior trim factory is not a nuisance per se, the bare fact that it may not be acceptable to near neighbors, and may produce some discomfort or inconvenience, will not in itself justify the factory's total elimination by injunction.—Id.

Duty of Officer—Compensation.

(Cal. App.) A statutory provision that a certain duty shall be performed by a specified officer means that such officer, and no other person, is chargeable with the performance of such duty, and when performed by the officer or by his authorized deputy the law regards the duty as performed by the officer, and a statutory provision for full per diem compensation of such public officer fixes the amount to be paid, regardless of who actually performs the service.—Sarter v. Siskiyou County, 183 P. 852.

Failure to Comply with Ordinance—Liability.

(Ill.) Failure to comply with an ordinance is merely prima facie evidence of negligence, and, if it does not cause or contribute to cause the injury, such failure does not impose liability.—Curran v. Chicago & W. I. R. Co., 124 N. E. 330.

NEWS OF THE SOCIETIES

Feb. 16-18.—INTERNATIONAL CITIES AND TOWN PLANNING ASSOCIATION. Annual meeting, London, England. Honorary secretary, C. B. Purdon, 3 Grays Inn Place, London, W. C., England.

Feb. 20-21.—AMERICAN CONCRETE PIPE ASSOCIATION. Annual meeting, Chicago, Ill. Secretary, G. E. Warren, 210 South LaSalle street, Chicago, Ill.

Feb. 25.—NEW JERSEY SEWAGE WORKS ASSOCIATION. Annual meeting, Trenton, N. J. Secretary-treasurer, Frederick T. Parker, Guarantee Trust Bldg., Atlantic City, N. J.

Feb. 26-27.—MATERIAL HANDLING INDUSTRY. Annual Convention at New York. Secretary, Zenas W. Carter, 35 West 39th street.

March 8-9.—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. Annual Convention at French Lick, Ind. Secretary-Treasurer, L. R. Taylor, French Lick, Ind.

March 10.—VERMONT SOCIETY OF ENGINEERS. Meeting and convention at Burlington Vt. Secretary, George A. Reed, Montpelier, Vt.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth annual convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

Oct. 4-8.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln avenue, Valparaiso, Ind.

◆

The National Federation of Construction Industries.

The first annual meeting will be held on March 24-25 at Hotel Sherman, Chicago, and will be of importance to all producers, manufacturers and distributors of construction materials, machinery and supplies, contractors, architects, engineers and municipal and financial interests connected with construction.

The purposes of the federation are to extend construction, improve its conditions by permitting close co-operative relations between the different interests concerned; to secure satisfactory conditions between the industry and the general public, including the Government, labor and consumers; by serving as an exchange between special construction interests, and by taking the initiative in investigations, policies, propaganda, legislation and other actons advantageous to the industry.

Among the subjects to be discussed at the annual meeting by the best known national and international authorities are:

Freight Traffic as affecting the construction industry, freight rates, economical packing and handling in the shipment of construction materials.

Standardization in the construction industry. During these times of high prices of material and labor and increased demand for production, standardization holds out to the industry the one great hope for making production approximate demand at a non-prohibitive price.

Foreign Trade. American construction interests are realizing and grasping as never before the opportunities for branching out into world trade. Are you taking advantage of them?

Financial Relations. Adequate financing of construction operations will be given serious consideration. The questions of Federal home loans, exemption from taxation of certain of the income from mortgages on real estate, etc., are before us.

Jurisdictional awards.

Housing.

Americanization.

The Indiana Sanitary and Water Supply Association.

The next annual convention will be held March 8 and 9 at the French Lick Springs Hotel, French Lick, Ind., where it is believed that the new departure of assembling outside of Indianapolis is justified by the advantages offered by the health resort which offers special rates for this occasion.

New Jersey Sewerage Works Association

The next annual meeting will be convened at the State House in Trenton at 11 a. m., Wednesday, February 25. The papers to be presented and discussed include:

"Some Historical Notes on Sewerage Disposal," by M. N. Baker of the Engineering News-Record editorial staff.

"A Sewer System and Sewerage Treatment Plant as a Public Utility," by I. Z. Collings, president, Collingswood Sewerage Company.

"Sewer Cleaning in Atlantic City," by Frederick T. Harper, vice president, Atlantic City Sewerage Company.

The New England Water Works Association.

The January meeting was held at Hotel Brunswick, Boston, February 11, Henry V. Macksey, president, Frank J. Gifford, secretary. The meeting of the executive committee in the headquarters at the Tremont Temple was followed by a luncheon, and in the afternoon papers were presented by Professor George F. Swain, Harvard University, on the "Creation of a National Department of Public Works," and by Edward B. Eldredge, superintendent, Water Company, Onset, Mass., on "Economy in Pipe-lines for Small Water Systems."

Concrete Road Construction Conference.

The Association of Mississippi Valley State Highway Departments held a joint conference on Concrete Road Construction at Hotel La Salle, Chicago, February 3-4.

Contractors and material and equipment men were in attendance, and the program concluded with an exhibition of stereopticon slides and moving pictures showing special features of the design and construction adopted by different highway departments and moving pictures showing the methods of constructing concrete roads.

Among the topics presented for discussion on the floor of the convention were:

Methods of Letting and General Contracting.
Methods and Arrangements.
Who Shall Furnish the Materials?
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American Association of Engineers.

Representatives of all chapters of the American Association of Engineers in Ohio met in Columbus January 21 and formed the Ohio Assembly of A. A. E. The objects of the state organization were defined "to initiate, co-ordinate and promote the interests and achievements of A. A. E. in the State of Ohio."

It was tentatively decided that representation in the state assembly would be on the basis of one representative from each chapter having from 20 to 100 members, two from chapters having 101 to 500 members and three from those with from 501 to 1,000 members, and that voting power would be on the basis of units of 100 members represented. Thus the representative from a chapter having not over 100 members would have one vote, while the three representatives from a chapter having between 400 and 500 members would have five votes.

A committee was appointed to draft a constitution to submit to the chapter for discussion.

Plans were discussed and agreement reached that a state secretary should be employed in the near future and state headquarters opened in Columbus. Another development of the future is to bring together all members of the state in an annual get-together meeting, partly for social purposes and partly to discuss matters of common interest. Members and applicants of A. A. E. in Ohio now number about 1,500. Chapters are being formed at Canton, Youngstown, Newark and Marion. The existing chapters are Akron, Cleveland, Dayton, Cincinnati, Toledo, Ohio Valley, Steubenville, Ohio Northern and Columbus.

The Louisville Club of the American Association of Engineers has elected H. T. Best president, and H. B. Cassin, secretary. The Louisville Club was responsible for the recent introduction of an engineers' license bill into the Kentucky legislature

The Rapid Transit Engineers Section of the New York Chapter of the American Association of Engineers which was organized in December, now has about 200 members. The members of the section received an increase of $300 a year when the Board of Estimate of New York approved the Transit Construction Commissioners Budget on December 31. This increase was largely as a result of the efforts of L. B. Smith, assistant district secretary of the American Association of Engineers in New York.

At the first annual convention of the Southwestern District of the American Association of Engineers in Globe-Miami, Arizona, the old officers of the district, who were formerly officers of the Southwestern Society of Engineers, were re-elected. It was voted that the name be changed from the Southwestern Society of Engineers, Southwestern District of the American Association of Engineers to the American Association of Engineers, Southwestern District. Dean G. M. Butler of the college of engineering of the University of University of Arizona is president.

Major Frank T. Payne has been elected president of the Louisiana Chapter of the American Association of Engineers. Major Payne is superintendent of the state department of conservation.

At the first annual convention of the Idaho Society of Engineers, now the Idaho Chapter of the American Association of Engineers held in Pocatello on January 12, the following were elected as officers of the new organization, which is officially known as the Idaho Society of Engineers Chapter of the American Association of Engineers: President, E. B. Darlington, Jerome, Idaho; vice-presidents, C. N. Little, dean of the engineering department, State University of Idaho, and E. E. Moberly, of Pocatello. The secretary-treasurer is A. M. Ayres, of Boise. A constitution and by-laws were adopted.

The Detroit chapter has elected the following officers: P. W. Keating, president; J. S. Lillie, first vice-president; E. L. Brandt, secretary; and J. T. S Southern, treasurer.

Wm. J. H. Strong, president of the Chicago Chapter of the American Association of Engineers, delivered an address at the annual dinner of the Indiana Engineering Society on Friday evening, January 23, in Indianapolis. The subject of his talk was "Advertising for the Engineer."

Material Handling Machinery Manufacturers' Association.

The next convention will be held at the Waldorf-Astoria Hotel, New York City, on Thursday and Friday, February 26-27. The program includes routine business at the first session, 10 a. m., February 26; a formal luncheon, with addresses by prominent speakers, at 12:30 p. m., and the presentation of papers on "Uses and Misuses of Material Handling Machinery," followed by their discussion, and by moving pictures in the afternoon.

On February 27 the morning session will be devoted to the meeting of the advertising council and to papers and discussions on association publicity. The afternoon session will be occupied by an outline of the plans of the association work in 1920 and by the presentation and discussion of papers on material handling machinery installations, illustrated by moving pictures.

International Waterways Commission.

The development of the St. Lawrence River for navigation and industrial purposes, between Montreal and Lake Ontario, was discussed by the joint meeting of the United States and Canadian Water Ways Commissions, held in New York, February 11.

Recommendations were invited relative to methods of procedure, cost of operations and maintenance for both countries, methods of control and extent of development of resources, commerce and industry involved.

Investigations of the Bureau of Standards.

The Bureau of Standards, Department of Commerce, announces a number of recent interesting investigations among which are the following:

Accuracy of Electrical Measuring Instruments.

An exhaustive paper on "The Accuracy of Commercial Electrical Measurements," requested by the Instruments Measurements Committee of the American Institute of Electrical Engineers has been finished and submitted to the chairman of the committee. This paper is scheduled to be given at the convention in February, in the hope of arousing interest in the further standardization of electrical instruments.

The paper discusses the accuracy required in commercial electrical measurements and the means of obtaining it, namely, proper choice, installation, use, and maintenance of instruments. Conditions of use, external disturbing influence, and features of design and construction affecting the accuracy for measuring voltage and current are mentioned. The sources of error in electrodynamic wattmeters are discussed, including the effect of instrument transformer errors. The principal factors affecting the accuracy of watt-hour meters are given. In conclusion, some improvements which should be soon forthcoming are mentioned.

INDUSTRIAL NEWS

The Ransome Concrete Machinery Company, Dunellen, N. J., have placed their New York office, 150 Nassau Street, in charge of Lemuel Smith, Jr., F. G. MacDonald and James H. Fitzgerald. Mr. Smith, who has been with the company for a number of years, has for the past two years been assistant sales manager. Mr. MacDonald has been selling Ransome Mixers in the New York territory for a number of years, and Mr. Fitzgerald, has been in charge of the Pneumatic Mixer Department of the Ransome Company for a number of years, being recognized as an authority in this line of work.

New Office Opened—The United States Cast Iron Pipe & Foundry Company announce the opening of their office in the Scollard building, Dallas Texas, in charge of T. W. Hanlon, Southwestern sales agent.

Mace Moulton, Jr., who has been for the past six years New England sales manager for the United States Asphalt Refining Company of New York and Baltimore, has formed the firm of Mace Moulton, Jr., Inc., with offices at 6 Beacon street, Boston, to handle the sale of bituminous road materials and pavements.

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The Engineering Service Corporation has absorbed and succeeded to the business of the W. K. Palmer Company, engineers, enlarging and extending the scope of that business which was developed from the personal consulting engineering practice of Mr. Palmer, established in Kansas City, in 1901.

A corps of specialists and experts, consulting, designing and supervising engineers, with the advantages of an efficient organization, will be maintained. The scope of the activities of the corporation will comprehend the engineering, organizing, financing, constructing, operating and managing of public utilities and industrial properties.

The Engineering Service Corporation will specialize in the preparation of plans, specifications and estimates, and the supervision of construction of electric lighting plants and lighting systems, electric railways and power plants, hydro-electric plants and transmission systems, water works and water supply systems, electric railways and power plants, hydro-electric plants and transmission systems, water works and water supply systems, municipal improvements, and all kinds of factories and industrial establishments. railway locations and surveys for steam and electric railways and survey for irrigation and drainage systems, with the attendant office work: preparation of maps, profiles, topographic data, etc., also constitute a particular specialty.

Special attention will be given to expert examinations, appraisals, inspections, tests and reports, and reports necessary for the financing of new projects and the refinancing of existing properties; the construction, operation and management of utilities and industrial properties and the negotiating of securities of such properties.

The plan of organization, and the aim and purpose of the Engineering Service Corporation are designed to cover a field in which there is a demand for such combination of talent and facilities, together with financial strength as is now offered, which is necessary for the complete handling within a single institution of all organizational, legal and financial matters relating to a public utility or an industrial project as well as the details of the necessary engineering and construction work, with the advantages of centralized responsibility.

Lecture Series by Barrett Co. Staff Very Popular.

The engineering staff of **The Barrett Company, New York City,** has for several years, at the request of universities and colleges, given talks to engineering students and for road schools and technical societies, on various phases of the application of coal-tar materials to the solution of modern road problems. The interest in this work has been widespread and the colleges appear to be very glad to avail themselves of the opportunity to receive practical first hand information on highway construction work. The calendars of the lecturers are well filled and many of the colleges have requested the whole series of lectures.

The company has issued a pamphlet describing this lecture work. The following subjects are covered: "Chemistry, Manufacture and Control Testing of Refined Tars;" "The Laboratory Tests to Which Road Tars Are Subjected;" "The Construction of Pavements with Refined Tar;" "City Pavements of the Block Type;" "Wood Preservation;" "Wood Block Pavements;" "Maintenance;" and "Maintenance of Broken Stone and Gravel Roads."

Partnership Changes.

The firm of Chester & Fleming, engineers, Union Bank Bldg., Pittsburgh, Pa., announces that Thomas Fleming, Jr., has withdrawn from the firm to become associated with the Oil Well Supply Co. Daniel E. Davis, on the staff for several years, and during the war, a captain in the Construction Department of the U. S. A., has become a member of the firm. John T. Campbell, for several years in charge of designs, has become a member of the firm. The partnership will continue to operate under the established firm name of Chester & Fleming, with J. N. Chester, J. T. Campbell, D. E. Davis and J. F. Laboon as the partners.

The Material Handling Machinery Manufacturers' Association, 35 West 39th street, New York City, has issued a report describing its work in the past eight months and outlining its purposes and plans for the future. The organization succeeded in having New York City provide mechanically equipped piers instead of ordinary man-handling piers prosposed. The tremendous possibilities of mechanical handling are pointed out and the effects on important national economic questions such as the increased productivity of labor, the high cost of living, etc., are discussed. The equipment included in the sphere of the association covers cranes, hoists and winches, conveyors, elevators, industrial trucks, tractors and trailers, bulk handling machinery, etc.

Calvin Tomkins is president and Zenas W. Carter secretary of the association.

Materials Required for French Reconstruction.

The following facts regarding the magnitude of the reconstruction task confronting the French Minister of the Liberated Regions were given out by M. Labbe, Director General of the Technical Services.

Building work alone would require 22,000,000 tons of material and the labor of 700,000 people for one year; 100,000 houses are to be entirely rebuilt, requiring 5,000,000,000 bricks, 3,000,000 cubic meters of sand, 1,000,000 tons of lime, 13,000,000 square meters of tiles, and 3,000,000 cubic meters of wood. Reconstruction of highways and railroads would require 3,000,000 tons of materials and the labor of 15,000 men for one year. An addition of 20,000 trains and 5,000 trucks would be required.

"Direct Oxidation" Sewage Disposal Process.

The board of directors of the **National Lime Association** has authorized the publication of bulletin No. 200 on sewage disposal, dealing particularly with the direct oxidation process.

Big Water Scheme for English City.

The Liverpool (England) Corporation proposes laying out a fourth line of pipes from Vyrnwy Lake, in Montgomeryshire, to the corporation reservoirs at Prescot, 68 miles, as well as considerable alterations in the levels of portions of the third line, at a combined cost of approximately £5,000,000 ($24,332,000).

PERSONALS

Mullican, N. S., who has served Davidson County, N. C., several years as county highway and bridge engineer, has resigned to accept the position of highway and bridge engineer of Davie County, N. C. His new position pays a salary of thirty-six hundred, in addition to his retainer salary from Davidson County, where he will act as consulting engineer on all hard surface work.

Evarts, Charles W., health officer of New Haven county, Conn., was recently burned to death in a fire in the Chamber of Commerce Building, New Haven.

Grace, John P., was recently elected mayor of Charleston, S. C.

Collins, Thomas E., city engineer of Elizabeth for the past seven years, has been reappointed by the board of public works of that city for a term of three years.

Ledoux, J. W., consulting engineer, 112 North Broad street, Philadelphia, in order to adequately take care of his consulting engineering practice, has resigned as chief engineer of the American Pipe and Construction Company, and is now established as consulting engineer. He will specialize in water works, valuation, arbitration, rate cases, and water power development.

Hitchcock, L. B., city engineer of Phoenix, Arizona, has been elected president of the Phoenix Chapter of the American Association of Engineers. D. A. McClung, assistant county engineer, is secretary.

During the absence in Europe of A. M. E. Johnstone, the Wallace & Tiernan Co., Inc., have appointed Gilbert H. Pratt acting district sales representative for New York, New England and northern New Jersey.

Mr. Pratt was formerly chief chemist of the New York Continental Jewel Filtration Company, prior to which he was chief of the Rhode Island State Department of Health, after several years connection with the Massachusetts Health Department.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, FEBRUARY 21, 1920 No. 6

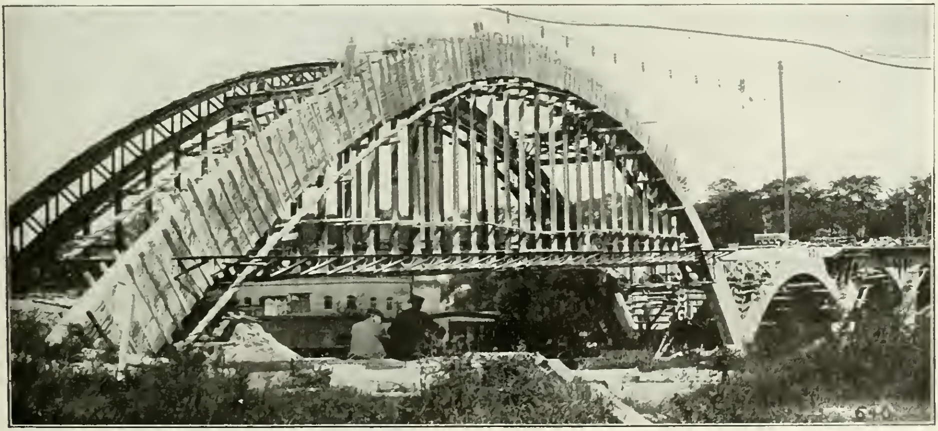
Self-Supporting Arch Rib Erection

Concrete bridge spans up to 200 feet long reinforced by structural steel members detailed and proportioned to carry the fresh concrete and resist all stresses during construction and subsequently to provide for tension and shear in the finished structure. Reinforcement trusses fabricated and erected in sections by derrick booms. Rib forms supported by reinforcement trusses and concreted by cableway.

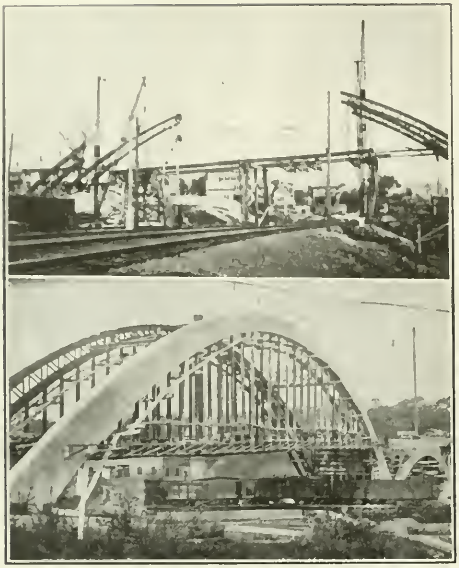
It has long been a desideratum to utilize for erection supports the potential strength of steel used for the permanent reinforcement of concrete arch ribs and girders. This has so seldom been accomplished that a very successful example is here described although the work was executed several years ago. The principles, however, have not been generally applied, and are at this time even more important because of the ever increasing cost of labor and materials, both of which were in this case diminished by the methods selected for an important piece of work of ordinary character, conditions, and requirements.

In Fitchburg, Mass., Fifth street is carried over the tracks of the Boston & Albany and of the New York, New Haven & Hartford railroads and across the Nashau river on a highway bridge 665 feet long with a 26-foot roadway and two 6-foot sidewalks supported on reinforced concrete arches, one of 32 feet, 7-inches span, one 76 feet, 3-inches, two 113-foot, one 115-foot, 9-inches, and one 200-foot, 4½-inch span.

Each span consists of two segmental monolithic ribs reinforced with structural steel trusses and connected, in the long span, by transverse steel struts enclosed in concrete. The ribs of all spans are in



Structural Steel Reinforcement Ribs for 200-Foot Span Erected. One of Them Supporting Concrete Forms for Ribs and Verticals.



Erecting Rib Trusses with Derricks. One 220-Foot Truss Concreted and Stripped.

the same vertical planes and the roadway which is suspended from the ribs of the 200-foot span is carried on the spandrel walls of the other, deck, spans.

The bridge is on a tangent and a 4 per cent. grade, the latter making it difficult to secure a uniform and symmetrical appearance of the arches, which were accordingly designed with different spans, rise, and curvature, which secured a very pleasing and graceful effect. The arches were treated so as to develop a uniform thrust of all spans at each pier, thus insuring stability and balanced forces, reducing the sizes of the piers and affording greater freedom of construction operations.

The arch ribs were so proportioned, and their structural reinforcement was so designed, that the cross-sectional areas required to resist the stresses of the finished structure were adequate for all of the erection stresses, thus providing for construction without involving any extra cost for the steel work.

The steel arch ribs were therefore designed for temporary service as independent elements, as well as for their permanent service. They were built with rectangular cross-sections and parallel top and bottom flange angles connected by riveted latticing in vertical and horizontal planes.

Each rib for the 200-foot span was fabricated in several sections, shipped separately, and erected by a pair of steel guy derricks, commencing at the ends and assembling successive sections, which were temporarily supported until the derricks lifted the center sections. The sections were connected by field splices, making complete and independent arches spanning the railroad tracks without obstructing them.

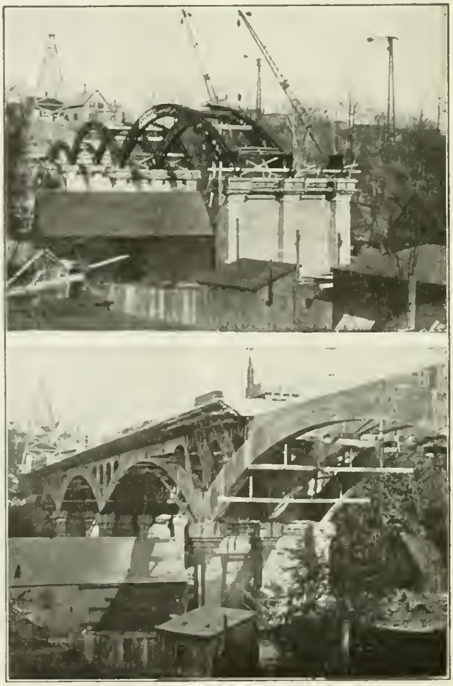
It was at first intended to attach vertical suspenders to these ribs before erection, then connect the floorbeams to them, working from above without occupying any portion of the right of way between the abutments. Later it was found practicable to erect falsework bents between the tracks, carrying on them overhead longitudinal I-beams clearing the train service and supporting the permanent roadway floorbeams, which were later suspended from the arch ribs without involving the preliminary erection of the vertical suspenders.

The ribs of the 32-foot 7-inch span were riveted up complete at the bridge shop and were erected as units by the derricks. The ribs for the remainder of the spans were shipped from the bridge shops in sections, assembled and riveted together in horizontal planes at the site and lifted bodily to position by pairs of derricks.

After the ribs of each span had been properly braced together, the forms for the concrete were built around them and supported by them. For the short spans, they were concreted by small movable mixers advancing at roadway level as the work progressed and providing all of the concrete for ribs, spandrels and floor.

A cableway parallel to the bridge axis was supported at one end of the long span on a mast and at the opposite end on a transverse bent, and served to deliver the concrete for the main span.

The bridge cost about $60,000. It was designed, and the erection method was devised by J. H. Fuertes, consulting engineer, and was built by the McHarg-Barton Co., contractor.



Short Span Reinforcement Trusses Erected. Arch Ribs Concreted, Cableway Installed.

Drag-line Rock Excavation for Large Dams

Buckets of 4½-yard capacity, electrically operated from 100-foot steel booms, handle great quantities of limestone and shale rock in Miami Conservancy District flood control work more safely, conveniently and advantageously and with a smaller labor force than could be done with steam shovels in cuts 100 feet deep, extending 63 feet below the level of the machine, which deposited spoil 37 feet above its track. The machine moved transversely in very wide cuts and in others completed the excavation in a single longitudinal trip.

The construction of the five great dams for the controlling works and retarding reservoirs required for flood protection in the Miami Conservancy District involved the excavation and removal of about 400,000 cu. yds of rock, about 70 per cent of which has been satisfactorily handled by large electric drag-line machines of the Lidgerwood and Bucyrus types. The rock was mostly of the Cincinnatian formation, consisting chiefly of limestone and shale, occurring in approximately horizontal strata from 1 to 6 inches thick, the remainder running up to a thickness of 5 feet.

To a depth of 10 feet below the surface of the ground the rock is weathered and rotted, and could be removed without blasting. Below that elevation it required to be drilled and blasted.

The cuts were comparatively long and narrow, with extreme depth and width of 100 feet and 380 feet respectively, extending from 22 to 38 feet below low-water level through a maximum thickness of 77 feet of rock.

Advantages of Drag Lines.

Very nearly all of the excavation was handled by large electrically operated drag-line machines that were selected in preference to the more rapidly operating, powerful steam shovels for several reasons, the principal ones being that they could complete the excavation of the full size cross-section of the cut as they advanced, thus permitting concreting to rapidly follow the excavation and to be commenced long before the completion of the latter; that the machinery could be set at a level far above the bottoms of the cuts, thus eliminating or greatly diminishing the danger from floods; that they could deliver the spoil at a much higher elevation above the track on which the machine was operated; that they were much more flexible in the adaptation to the varying width and depth of the excavation, and that the machines were operated with much smaller labor forces than would be required for steam-shovel operations.

At Englewood and Germantown.

At the Englewood and Germantown dams, where a total amount of 97,712 yards of rock was excavated, the deep trenches were from 30 to 100 feet wide at the bottom. The loose rock was excavated first to a depth of 7 to 10 feet below the surface of the ground, and tripod drills were set up in the bottom of the excavation, drilling holes with average depths of 18 feet and 28 feet, which were charged with about one-half pound per yard of 40 per cent dynamite, which loosened and shattered the material sufficiently for it to be loaded by the drag-line buckets into 12-yard air dump cars drawn by 40-ton locomotives. The sides, bottoms and corners of the cuts were trimmed with jap drills, and the trimmings were removed at Germantown by the drag-line buckets, and at Englewood were loaded by hand into skips lifted out of the pit by a locomotive crane.

Two-Trip Method at Huffman.

At the Huffman dam, where 39,500 yards of rock was excavated, the drilling was mainly done by a well drill, which averaged 45 feet of holes per day at a direct cost of 27 cents per foot, and by a wagon drill, which made a maximum record of 240 feet in one day. About 0.52 pound of dynamite were required per yard of rock.

The rock was blasted in three successive benches, each about 20 feet thick, and was removed by a drag-line machine, with a 4½-yard bucket operated by a 100-foot boom. At the first trip along the center line of the cut the machine removed the spoil from the upper bench, and at the second trip on the same line removed all of the remainder of the excavation from both lower benches, filling and lifting the buckets from a maximum depth of 64 feet below the loading track and 68 feet below the level of the ground on which the machine stood.

At Lockington.

At the Lockington dam, where the rock excavation consisted of only about 4,560 yards of hard limestone from 4 to 18 inches thick of the Silurian formation, the concreting followed very closely on the excavation, making it inadvisable to use large charges of explosives. Holes were therefore made with jap air drills and loaded with light charges, which broke the cut in sizes suitable for concrete plums and rip-rap at the rate of one yard of rock for each four pounds of 40 per cent dynamite. The rock was loaded by hand in 1¾-yard bottom-dump buckets handled by two 105-foot booms of guy derricks that delivered directly to the concrete forms or to 5-yard dump cars.

Transverse Method at Taylorsville.

At Taylorsville, where the maximum dimensions of the cut were 100 feet deep, 380 feet wide and 2,900 feet long, the 250,000 yards of rock excavation was overlaid by 523,000 yards of earth, most of which was removed by a hydraulic giant or monitor. For the rock cut, 77 feet deep, the drilling and blasting were done in two lifts, the upper one 26 feet high. Holes 4 inches in diameter were made 10 feet apart in rows 10 feet back of the space by three Cyclone drills operated by a 7½ horsepower electric motor at the rate of 50 linear feet per day. The holes were spaced 5 feet clear of the sides of the excavation and were not carried nearer than 2 feet from the bottom. From 75 to 100 pounds of 40 per cent dynamite or, later, of 72½ per cent gelatine dynamite, originally intended for the Italian War Department, were used for each hole.

Smaller holes were also drilled by three air machines, but neither the large nor the small holes were sprung because the strata penetrated were so thin and weak that they cratered and broken rock dropped from the enlarged upper part of the holes, filling the lower part and making it necessary to redrill the hole. The lower 2 feet of rock was drilled with jap drills and jack hammers, and blasted with 1-pound or 2-pound charges of dynamite. The holes, 3 feet apart, were from 4 to 6 feet deep, and the charges were exploded by electricity, sometimes in groups of as many as 235 at one time. About 0.72 pounds of 40 per cent dynamite and 0.5 pounds of the 72½ per cent dynamite were used per yard of rock.

The rock was broken into slabs from 3 to 5 feet thick, which required to be block-holed and blasted again to reduce them to a size that could be handled by the 3½-yard drag-line bucket operated from a 100-foot boom of the machine, moving transversely back and forth across the cut at an elevation of 63 feet above the bottom of the excavation, and handling material 37 feet above its base. The buckets delivered to 12-yard dump cars hauled, at the same grade as the machine, or 10 feet below it, by 40-ton locomotives.

Just above the rock there was a layer, 20 feet or more in thickness, of tough clay and hardpan, which was drilled by well drills, the holes sprung with dynamite and charged with 1 pound of black powder per yard of spoil.

This work was executed under the direction of the Miami Conservancy District, Arthur E. Morgan, chief engineer, and Charles H. Paul, assistant chief engineer, and described in the Miami Conservancy Bulletin.

Highway Prices and Highway Machinery

The survey of the highway situation in the Middle Atlantic States contained in the paper of Mr. Knopf, which is abstracted elsewhere in this issue, contains a number of points of interest, and suggestions to which highway officials may well give heed.

One of these is the statement that last year bids which were received late in the season, ranged ten per cent to fifteen per cent higher than those submitted earlier in the season. Even though there were no difference in the prices submitted, the advantages of letting contracts early so as to make it possible to complete the work during the season should of itself be sufficient incentive for the immediate letting of highway contracts contemplated for this year. When there is added, however, the further inducement of better prices obtained by early letting, there would seem to be no good reason for deferring such lettings and every reason for hastening them where possible; and with a forceful man at the head of affairs mighty few things are impossible.

Another feature which stands out prominently in this report is the scarcity of labor, which threatens to be even greater this year than it was last. Mr. Knopf believes that, to meet this exigency, contractors will make greater use of labor-saving machinery and devices. There seems to be little question that the highway contractors, who are to handle economically and profitably any considerable part of the work which it is possible for them to obtain this year, will resort to mechanical substitutes for the labor which it is impossible to secure, and so much of which, when secured, is found to be inefficient.

In many cases the use of such devices will be found to directly reduce the cost of construction, in view of the present high wages demanded; but even where there is no direct saving, the possibility of increasing the output and completing a contract which otherwise might have to hold over to another season will in the long run prove profitable by eliminating the no inconsiderable expense involved in such carrying over of contracts, which requires the storing and protection of machinery and materials, with more or less loss of the latter, and other expenses with which contractors are well, and some of them disastrously, familiar.

City Managers

Ten cities having an aggregate population of approximately 100,000, have come under the commission-manager system of municipal government in the last three months. The largest of these are Muskegon, Mich., with 25,500 population; Lynchburg, Va., with 21,830, and Newport News, Va., with 20,000. The smaller communities adopting this form include West Palm Beach, Sanford and Tallahassee, in Florida; Pittsburg, Cal., Painsville, O., and Sallisaw and Walters, Okla.

There are, in the United States more than 160 cities having city managers. Of these more than fifty are cities of more than 10,000 population. Three of them, Grand Rapids, Mich., and Dayton and Akron, O., having more than 100,000 each.

PUBLIC WORKS

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A. PRESCOTT FOLWELL, *Editor*
FRANK W. SKINNER, *Associate Editor*

200 Per Cent Profit Without Risk

In a recent discussion of post-war reconstruction, Alfred E. Marling, president of the Chamber of Commerce of the State of New York, called attention to the estimates that a 10 per cent increase in production would cut 20 per cent from living costs and that another 10 per cent reduction in buying unnecessaries would insure an additional 20 per cent decrease in prices, thus effecting a total decrease of 40 per cent in the high cost of living.

The plea to make these simple and easy percentages is the fundamental element of renewed prosperity and safety not only in this country, but throughout most of the civilized world. It strikes at the root of the pernicious, still increasing and wholly unnecessary high cost of living and shows plainly the way to destroy practical profiteering whether by producers, dealers or by labor. It is the blessed gospel of thrift and efficiency which every honest citizen should preach and practice.

Erecting Concrete Arches without Falsework

The description in this issue of the erection of long concrete arch bridge spans without the use of temporary falsework is of special interest and importance in that it indicates a method which is available in some instances for a material reduction of construction costs on important work. The method is based on the very sound principle of utilizing during construction operations the potential strength of portions of the final structure while the latter is in an incomplete state.

In many reinforced concrete structures the reinforcement steel could, if properly utilized, support the structure during erection or construction; but as it is generally detailed solely for service in the finished structure after it is embedded in a solid mass of concrete it cannot be easily made available for preliminary service. In this case the designing engineer dimensioned the structure and detailed the steel ribs so that the latter were independently efficient and were sufficient both for permanent and temporary stresses. In many cases where the original designs do not make this provision it would be possible for the contractor to secure such modifications effecting this result as would enable him to materially reduce the cost and increase rapidity of construction.

The Obsolescence of Two-Course Concrete Pavements

The reports of concrete pavements laid in a large number of cities in 1916 show that 24 per cent were laid with two courses; in 1917 28 per cent were laid in two courses, while in 1919, the percentage has diminished to 11 per cent, indicating that the construction of concrete pavements in two separate operations is rapidly becoming a thing of the past.

The principal advantage claimed for the two-course concrete pavements was the opportunity to effect an economy by using a cheaper concrete with less cement in the lower course than in the upper course. The disadvantages are the necessarily impaired strength for the same thickness of pavement; longer time spent in construction; greater opportunities for poor work, mistakes and defects; the danger of separation between the upper and lower courses; and of the cracking and disintegration of the latter.

At the present price of cement, and considering the leanest mixture likely to be used for a 6-inch base course, and the richest one for the 2-inch wearing course, the saving in cost of cement can hardly exceed about 50c per square yard which is offset by the increased labor cost. Assuming the cost of labor for concreting alone in a one-course pavement to be a very conservative minimum of $1.25 per square yard for one-course pavement. it will be very nearly doubled for a two-course pavement of the same thickness where all of the operations are repeated, and at nearly the same speed, except that of finishing which is only a few cents a square yard. Besides this, the surface of the base course may require protection or repairs and if the top is covered with dust, leaves, rubbish, or any other foreign material, it must be removed and the concrete thoroughly cleaned before the second course can be laid. The placing of the second course is also somewhat critical because if it is too long delayed, bonding with the first course will be imperfect, and if it is laid too soon, there is difficulty in working over the first course.

It therefore appears that there is little or nothing to be gained and considerable to be lost in making a concrete pavement with two courses. A massive monolithic pavement with uniform strong concrete throughout possesses greater bearing, bending, and distributing strength than a laminated pavement of the same dimensions; is likely to be cheaper, more durable and satisfactory than the former, so that we may look with satisfaction at the general disappearance of two-course concrete pavements except in cases where a concrete wearing surface can be advantageously placed on existing concrete base or under occasional special conditions.

Public Works' Strikes

The right to strike, that is to quit work, is in most cases undeniable for individuals and in many cases, right for groups and trades. Under proper conditions and rightly conducted, such strikes may be beneficial and desirable. They must not however, spell conspiracy, nor be attended with violence and intimidation, nor effect a breach of trust, nor seriously jeopardize the comforts and welfare of the general public or the safety of innocent victims. Too often these points have been disregarded or even wantonly violated and in a large number of cases strikes have proved to be brutal and dishonest weapons in the hands of piratical trusts and as such, a great menace to safety and prosperity and a principal factor in the present reduced production and high cost of living.

Labor is entitled to a living wage proportioned to its efficiency and reliability, to good working conditions, and to collective bargaining. It is not entitled to enforce extortionate demands, reduce efficiency and output, nor to either actively or passively endanger the public safety or property.

Labor engaged on the production, maintenance and operation of public works and utilities (as well as the great general necessities like food, fuel and transportation) is to a large extent safeguarded by permanent employment, and certain compensation. The individuals all undertake this work voluntarily, are generally not subject to arbitrary dismissal, and are often eligible for some form of direct or indirect pension. If they have grievances, the public can be safely counted on for sympathy and eventual remedy.

These men are therefore emphatically in a class by themselves, with special privileges and special responsibilities, and are in every way bound to fulfill their trust and not to desert their posts, collectively, any more than the captain and crew of a ship at sea. Such strikes, especially like those of the railroaders and coal miners, may cause inconceivable suffering and damage, while strikes in the police, post office and fire departments, waterworks, and other great essentials would soon cause deaths, public paralysis and even anarchy. Yielding to such strikes is a national humiliation resulting in aggravated burdens to the citizen for the sake of political schemes and in a financial gain to a minute percentage of the population at the serious expense and distress of the remainder. Such strikes should be absolutely prohibited by immediate legislation and severe penalties provided for their punishment. If the Railroad Bill neglects to provide against strikes, it will be a national calamity.

Rational Selection of Costly Excavating Plant

The importance of selecting and installing construction plant and equipment so as to secure the greatest ultimate satisfaction, rather than to get a possibly greater limited maximum product or lower cost under temporary or uncertain conditions, is clearly brought out by the article on page 113, that describes the installation and operation of dragline excavating machines for a large amount of heavy rock work of a nature for which different methods and equipment are often used.

In this case about $25,000,000 is being expended on heavy construction intended to prevent disastrous effects from future floods in the Miami valley. In the last analysis, after taking into consideration all the conditions that could be foreseen as likely to influence the operation of the machinery, the balance was in favor of the simpler method and plant.

Much of the work was of a character where more rapidly operating and more powerful steam shovel equipment might have been expected to be capable of working at a lower cost. This advantage was not disproved, but it was believed to be limited and somewhat uncertain and to be offset by important disadvantages that were considered to outweigh it. While the dragline buckets are less powerful, and cannot work as positively nor handle material as rapidly as the large shovels, they possess greater flexibility of operation and installation; command very large areas without moving their positions; can be installed in working position more quickly and cheaply than the steam shovels; can be operated under water; have a far greater range of operation in excavating far below their own level and in delivering material far above it; do not require difficult and expensive installation, maintenance and operation of dump car trains; can be advantageously operated by electricity from a central plant; and they require a much smaller equipment of scarce, costly, and unreliable labor. They were also much less in danger from floods in localities inevitably subject to heavy freshets. These considerations fully justified the selection of the type of machinery which has there proved eminently satisfactory in service.

Prepare for Work in Time of Waiting

Efficiency spells, in capital letters, success, satisfaction, and prosperity. The vital element of efficiency is preparedness; and for all kinds of construction operations prime essentials of preparedness are organization, equipment, materials, plans and schedules.

Every constructor now knows the general character and amount of the work that he may do this year and whether or not it is already definitely ordered, or depends on future deveolpments and contingencies, he knows in a general way what the requirements should be, at least the vital ones. If he has not alrady made reliable definite plans to meet them, he should lose no time in doing so in the short period now remaining when operations are sidetracked by the winter season, and new work is not yet contracted for.

Important work should be carefully studied not only to determine the requisites for its execution, but, no less to find by expert anaylsis if reasonble changes in the design and specifications may not secure economies of time, labor and materials, that will richly repay both the owner and the constructor without detriment to the structure.

When these are determined promptly, the office organization, as well as the field personnel of superintendents, engineers, inspectors and principal foremen should be at least skeletonized and lines laid for securing skilled labor if any large amount of it will be required.

Most of all, it is necessary that all existing equipment likely to be used, should be thoroughly overhauled and put in the best working conditions and so far as practicable, tested in operation, and that orders should be promptly placed for all the new plant and machinery that are sure to be required,

Road Concreting Speed

One hundred and twenty-six feet of 16-foot pavement laid in one hour with two-yard mixer and special system for delivering and handling materials.

G. P. Scharl, contractor for 5 miles of 16-foot concrete road in Branch County, Michigan, has installed plant and methods of operation enabling him to handle the work in large units and with great regularity and continuity that have resulted in placing concrete at the rate of 55 cubic feet in about every 75 sec. and securing a maximum progress of 126 feet of finished pavement per hour.

Materials are delivered in cars shunted from the main line railroad track to a switch alongside the storage bins. Bulk cement is received in gondola cars covered with heavy canvas and is unloaded into a stationary elevated bin by a clamshell bucket suspended from the boom of a derrick car.

Each side of the cement bin is an elevated aggregate storage bin built on a flat car installed on a dead end track. The gravel and sand bins are filled from cars on the switch alongside by the derrick car which is self propelling and spots and shifts the cars on the switch.

The switch is long enough to accommodate sufficient cars to provide for ordinary interruptions in the railroad service and the bins are large enough to insure constant automatic supply to the service cars.

An industrial track alongside the storage bins is run to and parallel with the road construction, being shifted to keep pace with the progress of the mixer and being provided with facilities for shifting and returning the empty cars. Flat cars installed on the service track are each provided with a 55-foot capacity wooden material box, which is in effect a rectangular, bottom-dumping bucket with the flaps controlled by links pivoted to vertical slide bars.

A group of cars each carrying one empty box is pushed alongside the gravel bin and 30 cubic feet of gravel are discharged by gravity into each box. The cars are hauled to position alongside the cement bin, where each box similarly receives 10 cubic feet of cement. They are again hauled to the sand bin and the boxes are filled up with 15 cubic feet of sand each.

Beyond the sand bin the teams are replaced by a gasoline locomotive that hauls the train alongside the mixer. Here a locomotive crane mounted on traction wheels lifts the boxes successively by double pairs of chains attached to the vertical bars and to the sides of the boxes, swings the boxes over the charging hopper of the mixing machine and dumps their contents into the hopper by manipulating the vertical sliding bars which are controlled by a special device designed by the contractor and built in his field shop.

The special 12-ton mixer constructed according to the contractor's specifications, is mounted on wide-tire wheels that do not require plant tracks to be laid on the sub-grade. It is moved forward by the locomotive crane that unloads the service cars. When in regular operation the machine mixing each batch at least 65 sec. has concreted 700 linear feet of pavement per day with a maximum run of 126 feet per hour and an average of 70.4 feet per hour. The machine is supplied with water pumped by the contractor.

As the mixer advances the concrete is screeded with a steel bound template curved to the radius of the required crown and the surface is compacted and excess water flushed out by rolling. The transverse expansion joints are finished with a 4-foot split float, the longitudinal sides are worked with an edging tool and the wet concrete is covered with cannas and protected with 2 inches of wet earth applied not later than the morning of the day after concreting. All curves are widened and superelevated and the road is opened after 18 days.

Charles Warren Hunt

Appreciated and relieved after twenty-five years' faithful service as chief executive of American Society of Civil Engineers.

After 25 years of devoted and efficient service as secretary of the American Society of Civil Engineers, Doctor Charles Warren Hunt has been made Secretary Emeritus, at a salary of nine thousand dollars and has been granted a six months' leave of absence to recuperate his health.

During his notably efficient administration as chief executive officer of the great national technical society, its membership has grown from 1,808 in 1895 to 9,403 at the present time. The dignity and reputation of the society have kept pace with its prosperity and are due to no other individual so much as to Dr. Hunt whose high executive ability, financial judgment and unwearied devotion to the society were fully appreciated and relied upon by the Board of Direction, composed of its most eminent members, that have guided its policy.

In addition to the ethical and technical progress which have made this society a standard for high thinking and great doings many important improvements largely due to Dr. Hunt's initiative have been developed both in the conduct of the important business of the society and of the library and in its professional activities. Including, notably, the volume and character of the society's publications, the extremely important participation in the St. Louis National Engineering Congress of 1904, and the successive development of the society's quarters from the remodelled residence on 23rd street to its own building on West 67th Street, and later to the present quarters in The Engineering Society's Building that were designed expressly to take the utmost advantage of co-ordination between it and the other three great national societies.

Dr. Hunt is a civil engineering graduate of New York University and after sixteen years of active professional experience in construction and maintenance operations he commenced in 1892 a three years' service as assistant secretary followed by the 25 years of responsible office that has just terminated, and for which it will be hard indeed to find a successor of equal ability and devotion.

Annual Paving Statistics

Facts and figures from several hundred cities concerning the amount and nature of work done by each during 1919. (Third instalment.)

TABLE NO. 1—SHEET ASPHALT LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cost per sq. yd.	Base Kind	Base Thickness, ins.	Base Cost per sq. yd. or cu. yd.	Surface, thickness, ins.	Binder, thickness, ins.
California:							
San Francisco...	128,072	$2.05*	Concrete	6	...	...	...
Connecticut:							
Hartford	36,725	3.04	1:3:6 concrete	6	...	1½	1½
Iowa:							
Sioux City......	20,000	4.23*	1:2½:5 concrete	5	...	1½	1½
Nebraska:							
Grand Island...	60,000	2.54*	1:5 gravel conc.	4	...	1½	1½
New Hampshire:							
Nashua	6,000	1.00§	Old macadam	...	...	...	2
New York:							
Buffalo	88,331	5.06†	Concrete	6	...	2	1½
New York–Bronx	46,100	2.50‡	Concrete	6	$8.00	...	...
New York–Manhattan	138,300	4.15	Concrete	6	2.77	1½	1½
Syracuse	6.59	2.00§	1:3:6 concrete	6	.90	2	1
Utah:							
Salt Lake City..	0.118	2.60	Concrete	6	...	1½	1½
Ohio:							
London	3,800	3.82††	Concrete	5	...	1½	1
Rhode Island:							
Providence	12,867	1.80§	Concrete & macadam	Conc. 6	1.55 & 1.10**	1½	1 & 1½
Washington:							
Seattle	5,786	...	....	...	...	...	...

*Includes grading and base. †Includes grading, base, curb and improvement complete. §Includes asphalt surface only. ‡Includes excavation but not base. ††Includes base, curb and gutter. **City furnished screened gravel loaded in contractors' carts; cost city $0.533 per sq. yd.

TABLE NO. 3—GRANITE BLOCK LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cost per sq. yd.	Base Kind	Base Thickness, ins.	Base Cost per sq. yd. or cu. yd.	Kind of filler
California:						
San Francisco ..	902	*$4.13	Concrete	6	...	....
Connecticut:						
Hartford	2,640	5.32	1:3:6 concrete	6	...	Cement
Massachusetts:						
Haverhill	6,894	†1.06	On old base	...	...	Cement grout
Lawrence	6,925	5.65	On old base	...	...	Cement grout
New Hampshire:						
Nashua	5,200	†1.25	On old base	...	...	Cement grout

TABLE NO. 2—BRICK PAVEMENT LAID IN CITY STREETS DURING 1919 —Continued.

City and State	Yards or miles laid	Average cost per sq. yd.	Base Kind	Base Thickness, ins.	Base Cost per sq. yd. or cu. yd.	Depth of cushion ins.	Kind of filler
Duquesne	4,640	3.35	Slag	8	...	2	Sand
Johnstown	39,461	4.285	1:3:6 concrete	5 & 6	...	I††	Pitch:cement
Texas:							
Temple	4,600	2.82*	Concreto	4	...	1	Asphalt
Washington:							
Seattle	30,123	3.85	1:3:6 concrete	6	...	Mono'th	Grout
Spokane	175	3.43	Concrete	5	...	¾	Grout
West Virginia:							
Huntington	18,213	4.24¶	Gravel	5	...	1	Sand
Moundsville	4,500	2.82	Gravel	6	...	2	Grout
Wisconsin:							
Wausau	13,000	3.50*	Concrete	5	...	1	Asphalt

*Includes grading. †Vertical-fiber brick. §Includes grading, base, curb, and improvement complete. ‡Brick surface only. ¶Includes curb, excavation and drainage. **Includes curb and gutter. ††I:4 sand-cement mortar.

TABLE NO. 6—BITUMINOUS CONCRETE LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Thickness, inches	Average cost per sq. yd.	Base Kind	Base Thickness	Base Cost
California:						
Pasadena	391	1½	$0.626	....	..	I
Santa Barbara	79,235	..	*1.98	Concrete	4	I
Vallejo	8,600	..	1.89	Concrete	4	$0.855
Kansas:						
Topeka	26,000	2	2.75	Concrete	5	I
New Jersey:						
Ridgefield Park ...	9,800	2	†2 28	Macadam	4	0.85
New York:						
New York - Richmond	34,020	2	†2.72	Old base	..	....
Syracuse	1.13	2	†1.95	Concrete, 1:3:6	6	0.90
Oregon:						
Eugene	4,000	1½	2.55	Concreto	6	I
Utah:						
Salt Lake	1,018	6	2.75	Concrete, 4" crushed stone	4	I
Washington:						
Seattle	14,693	2½	2.55	1:3:6 concrete	5	I
Spokane	18,239	3	2.48	Concrete	5	I

*Includes grading. †Does not include base. I—Included in pavement cost.

New York:						
Buffalo	§6,286	¶6.43	Concrete	6	...	Cement grout
New York-Bronx	71,300	‡4.81	Concrete	6	$7.05	Grout or asphalt
New York-Manhattan	175,000	•7.02	Concrete	6	...	Asph. mastic
New York-Richmond	10,669	‡5.40	Concrete	6	1.49	....
Troy	3,000	•3.40	1:3:6 concrete	6	...	1:1 cement grout
Pennsylvania:						
Duquesne	2,418	4.65	Concrete	6	...	Cement
Rhode Island:						
Providence	2,701	••3.13	Concrete	6	1.71	Cement grout
	4,420	3.14	Gravel	6	1.60	Cement grout

•Including grading. †Old blocks relaid. §Medina sandstone. ¶Includes grading, base, curb, and complete improvement. ‡Includes excavation but not base. ••Does not include base.

TABLE NO. 4—MISCELLANEOUS PAVEMENTS LAID IN CITY STREETS DURING 1919.

City and State	Kind of Pavement	Yards or miles laid	Average cost per sq. yd.	Remarks
New Jersey:				
Irvington	asphalt block	11,057	$4.14	....
New York:				
New York-Bronx	Durax block	15,000	5.25	relaid on old base
New York-Richmond	asphalt block	4,719	3.50	....
Troy	recut granite block	7,800	3.50	on 6" base, sand cushion, grout filler
Texas:				
Port Arthur	Shell with 1" gravel top	16	0.698	natural soil foundation
Washington:				
Raymond	Resurfacing plank road	11,000	0.99	....

TABLE NO. 2—BRICK PAVEMENT LAID IN CITY STREETS DURING 1919.

			Base				
City and State	Yards or miles laid	Average cost per sq. yd.	Kind	Thickness, ins.	Cost per sq. yd. or cu. yd.	Depth of cushion, ins.	Kind of filler
California:							
San Francisco...	11,497	$3.57•	Concrete	4	...	...	......
Kansas:							
Parsons	3,000	3.00	Concrete	4	...	1	Asphalt
Topeka	6,100	4.60	Concrete	5, 6 & 7	...	...	......
Massachusetts:							
Pittsfield	18,165	4.30•	Concrete	5½	...	¾	Cement
Michigan:							
Kalamazoo	11,000	4.00	Concrete	6	...	1½	Asphalt
Minnesota:							
Duluth	1,077	3.90	Concrete	6	...	1	......
Nebraska:							
North Platte....	22,500†	3.66•	1:3:5 concrete	5	...	1½	Asphalt
New York:							
Buffalo	20,752	4.95§	Concrete	6	...	1½	1:1 grout
Syracuse	0.86	3.50‡	1:3:6 concrete	6	$0.65	1½	Grout
Ohio:							
London	1,414	5.30••	Concrete	12	...	1	Cement
Pennsylvania:							
Athens	3,144	2.58‡	Concrete	6	10.00	...	Grout
Butler	5,140	3.73	Slag	9	...	1	Pitch

TABLE NO. 5—CONCRETE PAVEMENT LAID IN CITY STREETS DURING 1919.

City and State	Yards or miles laid	Average cost per sq yd.	Number of courses	Thickness, inches	Proportions of mixture
California:					
Oxnard	40,362	•$1.62	1	4	1:2½:5
Santa Monica	3,845	1.359	1	4	1:2:4
Connecticut:					
Greenwich	20,200	2.25	1	5 and 7	1:2:4
Hartford	1,185	1.86	1	7	1:2:4
Illinois:					
Winnetka	59,083	2.60 2.75 3.00	1 1 1	6 and 10 6 and 11 6 and 12	1:2:3
Iowa:					
Atlantic	5,000	2.94	1	6	1:3:4
Centerville	2,000	†3.81	1	6	1:2:3
Alton	30,165	†2 47	1	6	1:2½:4
Sioux City	52,600	†3.25	1	6	1:2½:4
Kansas:					
Topeka	6,000	2.50	1	6	1:2:4
Maryland:					
Hagerstown	1,600	....	1	8	1:2:4
Massachusetts:					
Greenfield	4,400	§3.62	1	6 and 8½	1:1½:3
Pittsfield	35,400	†3.00	1	7 and 9	1:2:3
Minnesota:					
Duluth	34,726	....	1	7	1:1½:3
New Hampshire:					
Nashua	700	2.00	..	....	1:1½:3
New Jersey:					
Irvington	21,427	2.40	1	6	1:2:3
New York:					
Depew	36,000	‡4.50	1	....	1:1½:3
Gloversville	20,000	¶2.65-2.95	1	6	1:2:3
New York - Richmond	30,156	†2.66	1	6 and 8	1:2:4
Troy	11,000	†3.23	1	7	1:2:4
Waverly	540	2.155	1	6	1:2:3
North Dakota:					
Bismark	29,000	3.20	2	Base 5, top 2	Base 1:4½; top 1:2:3
Oklahoma:					
Enid	18,300	2.69	1	6 and 8	1:2:3
Oregon:					
Eugene	4,000	2.40	1	5½ and 6½	1:2:3
Pennsylvania:					
Butler	747	....	2	6	1:2:4
Johnstown	9,041	3.041	1	6 and 8 or 9	1:2:3
Northampton	871	2.08	1	6 and 7½	....
South Carolina:					
Columbia	3,600	3.00	1	7	1:2:3
Utah:					
Salt Lake	1.97	2.75	1	5 and 6 to 7	....
Virginia:					
Newport News	13,000	....	2	Bottom 6, top 2	Bottom 1:3:6; top 1:1½:3
Washington:					
Chehalis	1,263	2.12	1	6	1:2:3
Dayton	9,000	2 75	1	6	1:2:3
Raymond	4,680	2.49	1	6½	1:2:3
Seattle	109,426	1.80 2.04 2.48 2 68	1 1 1 1	6 7 8 9	1:2:3½
Spokane	646	2.30	1	6	1:2:3
Winlock	10,000	2.08	1	6	1:2:4
West Virginia:					
Fairmont	5,400	2.70	1	6 and 8	1:2:4

•Grading averaged 18 cents per sq. yd. additional. †Includes grading. §Done by town forces; concrete cost, $9.03 per cu. yd. ‡Includes grading, curb and drainage. ¶Includes excavation and reinforcement.

Road Improvement by Citizens

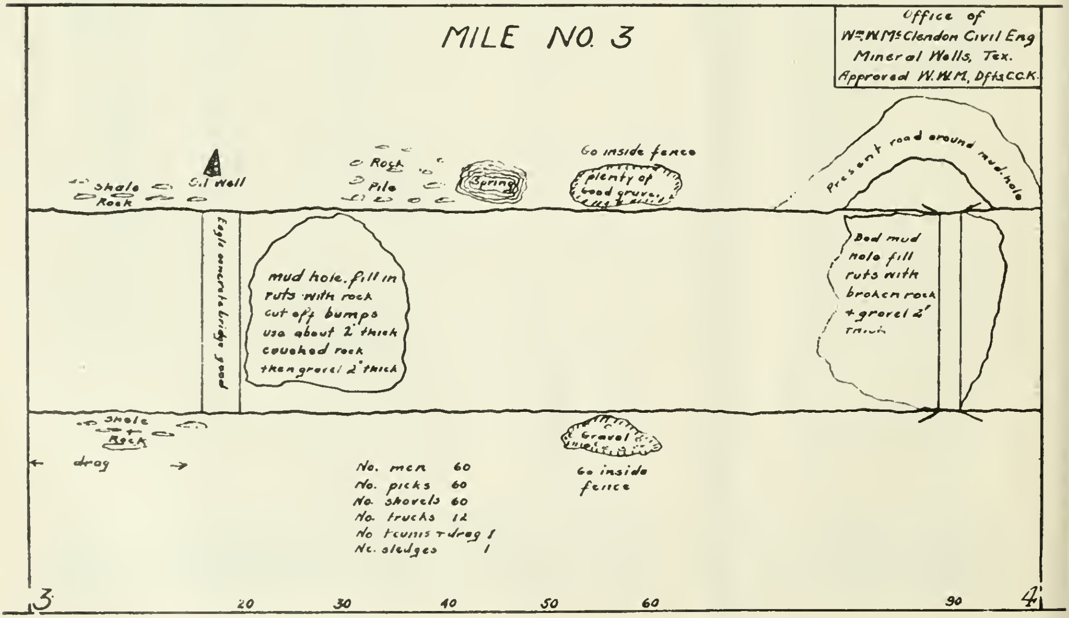
An unpaid citizen force of 1,270 men put in repair 35 miles of road which had been carefully mapped in 350 sections, with men, materials and equipment distributed on them by careful estimate.

Mineral Wells, Texas, a town of 10,000 population, is in the midst of the Texas oil fields, 54 miles west of Fort Worth. With the oil boom during the past two years the town has grown several fold in population, and the traffic on the roads leading to it has increased even more rapidly, a large part of this consisting of motor trucks. One of these roads, leading from Mineral Wells to the Stephens county line, a distance of 35 miles, carries traffic which a count made recently showed to average 67 vehicles an hour for 10 hours of the day, of which 45 per cent were trucks, the average load of which, excluding the weight of the truck, was 5 tons. This road was not originally intended for such a traffic nor was the county provided with a sufficient maintenance fund to maintain it, and by the summer of 1919 it had become almost impassable.

To improve this condition, the citizens of the town and the oil companies together raised $10,000 to be used in improving this road, to which sum was added $10,000 from the county and $20,000 from the state highway commission. A survey of the road by County Engineer M. V. Smith, however, showed that it would cost much more than $40,000 to put even the first ten miles in condition, the drainage structures alone averaging 3½ culverts and 3 bridges of not less than 20-foot span per mile. Estimate showed that the permanent construction provided for by this fund would be limited to a 4-mile stretch, leaving 18 miles still in a bad condition.

Sentiment in the county was found to be against a county bond issue, and the organization of a "shoestring" highway district was found to be illegal. In this emergency, the Chamber of Commerce originated the idea of a "good roads working day," and a canvas of the local business men resulted in all of them favoring the idea and being willing to close their places of business on such a day. William W. McClendon, city engineer of Mineral Wells (to whom we are indebted for this information), a paving contractor, and two other citizens, undertook to organize the work, the day being set as October 23rd. Mr. McClendon, County Engineer Smith and P. E. Beck (an engineer and manager of the Chamber of Commerce) examined the road for a distance of 35 miles from Mineral Wells, dividing it into one-tenth-mile sections and using an automobile cyclometer for measuring distances.

In making this survey, a note was made on the ground of every chug hole and mud hole, of good and bad


MILE NO. 3
Office of
Wm. W. McClendon Civil Eng
Mineral Wells, Tex.
Approved W.W.M. Dfts C.C.K.
Shale Rock
Oil Well
Rock Pile
Spring
Go inside fence
plenty of good gravel
present road around mud hole
Eagle concrete bridge good
mud hole. fill in ruts with rock cut off bumps use about 2" thick crushed rock then gravel 2" thick
Bad mud hole fill ruts with broken rock + gravel 2" thick
Shale + Rock
drag
Gravel
Go inside fence
No. men 60
No. picks 60
No. shovels 60
No. trucks 12
No teams + drag 1
No. sledges 1
3
20
30
40
50
60
90
4

Sample of Work Plan Furnished to Each Captain.

bridges and culverts, and where suitable road material (including gravel pits) could be found within three miles of the road. The approximate amount of material required for each mile section was estimated. This information was recorded on plans, there being 35 of these, each 12 inches long and 6 wide and each representing a single mile of road. Knowing the amount of work to be done in each mile section and that this work was to be done in one day, calculation was made of the exact number of men, teams, trucks, picks, shovels and other equipment necessary for each mile section. These facts and calculations were entered on the sheets, together with notes indicating the nature of the work to be done.

Blue prints of these sheets were made and bound into several books which were turned over to the committee for approval. Following this, a list was made of all available men, with their addresses and phone numbers, also of teams, trucks, picks and shovels, etc. It became evident at the outset that sufficient teams could not be obtained in Mineral Wells for working the further sections of the road, and another committee was appointed to solicit the use of teams from residents along the road. A captain was then selected for each mile of road and furnished with a list of the carpenters, laborers, teams, trucks, picks and shovels which he would need and where he was to obtain them. The captain was held responsible for notifying his men and securing his equipment. He was furnished with a blue print of his mile of road and was supposed to see that the work indicated was performed.

The fire chief of Mineral Wells agreed to blow the fire siren at five in the morning of October 23rd so that every man might be up and on his section of road by eight o'clock. That day opened with a heavy rain, however and the work was postponed a week and for the same reason postponed twice again; but on Friday, November 21st, the weather permitted the work to be performed. Mr. McClendon and his partner, A. B. Furnell, acted as general supervisors of the entire 35-mile stretch. The organization worked very smoothly and the work planned was completed in almost every section before the day ended. In one section 20 carpenters, under the captaincy of a local contractor, tore out and rebuilt a bridge of 10-foot span 6 feet high and 18 feet wide in one and a half hours, including setting in new posts and filling in approaches.

All business was suspended during the day, even to the cafes, and the full organization as originally planned turned out. This included 1,270 men, 1,000 picks and shovels, 175 trucks, 110 teams, 3 tractors, 4 graders, 6 road drags, together with post-hole diggers, sledges and other tools.

Spots that were impassable the day before were carrying 10-ton loads the day following, and the trucks encountered a hard surface where there had previously been boggy mud holes, and crossed the streams over 12 new culverts and 8 new bridges.

The appreciation which the work received from the people generally was manifested by an appropriation by the Chamber of Commerce of a maintenance fund of $2,000 a month to maintain the improvement by the patrol system. A vote of thanks was extended to Mr. McClendon for his services, to which it was stated that 90 per cent of the day's success was due; and a further motion was made that a day in December be set aside to work another road leading to the north, the same committee being placed in charge.

VOLUNTEER WORKERS ON ROAD AT MINERAL WELLS, TEXAS.

If the second venture is as successful as the first it will lead the officials of Mineral Wells to continue this idea of citizen co-operation until all roads in the vicinity are suitable for the traffic they are now carrying.

With the necessity for better roads and the speed by which they can be obtained held constantly before the citizens it will be a very short time until the roads of Mineral Wells are as good as any in the immediate and neighboring vicinities.

INCREASING PRODUCTION BY TRAINING.

The Department of Labor is contemplating the establishment of a United States Training Service for the purpose of furnishing manufacturers with training courses, enabling them to instruct their employes in new and modern methods of increasing production and output and decreasing costs. The reason for this is that, for want of training, the output of practically 7,000,000 of the 10,000,000 workers in manufacturing in this country is said to be equal to an average production of less than 50 per cent of what it can be made by proper and intelligent training in the various lines.

The effect of this training, system and energy even in such ordinarily unskilled work as saw mill operation is demonstrated by the record of a mill at Tupper Lake, N. Y. Here, skilled and expert sawmill men in the summer season alone equal the output of lumber and pulpwood that would be considered quite a comfortable full year's work for many plants using ordinary unskilled labor. A short time ago this crew cut 2,303 spruce logs in nine hours and twenty minutes, using two saws making the cut on an 8-foot band mill running 10,500 r.p.m. The logs were all spruce from 12 to 16 feet in length; no cut was made over 10 inches in width, and all were cut to 1¼ inch lumber. This is said to be a world's record. When the mill was built a few years ago its cutting capacity was to be 60,000 feet a day but with the expert crew it now has the daily cut rarely falls below 100,000 feet, which means an average of 2,000 logs every day.

House Heating by Electricity

The Public Utilities Commission of Idaho investigated the practicability of this for that state and concluded that it would never be feasible, practicable or economical, and such use of electricity would be extravagant and wasteful.

The Hydro-electric Power Commission of Ontario about a year ago published a report on heating houses by electricity in which it demonstrated the improbability that this would ever be done economically. The Public Utilities Commission of Idaho began to investigate the same subject about a year ago, hearings being held by the commission for nine days in December, 1918, and under the date of October 17, 1919, issued its report on the subject in a volume of 576 pages.

In two districts in Idaho there had been a certain amount of heating of houses by electricity, which had given rise to a consideration of the subject by communities throughout the state. The Minidoka government reclamation project heats houses in five towns at very low rates, averaging 66 cents per k.w. per month during the heating season. But here hydro-electric power is used for irrigation pumping during the summer, and the plant would be idle during the winter if not used then for some other purpose. The heating rate includes practically no overhead expense or fixed charges, and will be raised about 50 per cent next March, which will bring the cost of heating to somewhat above that by use of coal. Even here, heating has been discontinued during the early spring, when irrigation pumping begins.

It was generally conceded that it would not be practicable to use electricity generated by steam for house heating in competition with coal, for in electric heating only about 13½ per cent of the heat of the coal would be utilized, while 40 to 50 per cent would be utilized in coal heating.

It was assumed that an average six-room house in the southern part of Idaho would require 7 tons of coal a year for heating at an efficiency of 50 per cent, which heating would require about 25,000 kw.h. of electricity. The average demand would be 9.3 kw., but a much larger installation would be required to heat the house comfortably during extremely cold weather, which excess demand would be met by heat from stoves or furnaces. (In 105 houses heated electrically in the city of Twin Falls, all but six have such provision for supplemental heating.)

The Idaho Power Co. serves a district with about 100,000 population, or 20,000 homes. Allowing 25 per cent for losses in transmission, distribution, etc., to heat these homes electrically would require an installation of 258,000 kw. The total installed capacity of all present hydro-electric plants in southern Idaho is about 75,000 kw. and it is estimated that it would take all of the water power feasible for development in the state to heat about 77,000 homes, which is much less than the present number of homes in the state. Similar studies in Spokane, Wash., and in Toronto, Ont., Canada, showed that an extraordinary capacity, greatly beyond the present hydro-electric development, would be needed for house heating alone, and this would furnish a load only about seven months in the year, leaving an extremely large plant development idle during some five months.

To heat the average six-room house with seven tons of coal annually at $10 per ton costs $70 a year. The cost of electric heating would be, under the most favorable conditions, at least four times greater, and, by the testimony of Prof. H. V. Carpenter, this cost would be about $444 a year. Allowing for the fact that large additional installation would be required for proper heating, it is concluded that electric house heating would cost from six to nine times as much as coal in southern Idaho.

(The Ontario commission, for a colder climate, found 39,700 kw. h. of electricity needed for heating an eight-room house for a winter season, costing $1,191, or $397 at the low rate of one cent per kw. h.; while the same heat could be obtained by coal heating for $90.)

It was shown in the testimony that the heating of 15,000 homes in the district of the Idaho Power Company would save about 100,000 tons of coal annually, whereas a smaller amount of electrical energy would serve to electrify the entire system of one of the trunk line railroads in Idaho, with a resulting saving of about 1,000,000 tons of coal annually.

The findings and conclusions of the commission are substantially as follows: "Having made an earnest effort to secure all the light possible on the subject . . . we find no grounds for holding out to the people of Idaho a reasonable hope that electricity will ever be used generally for house heating in our state, and we are forced to the conclusion that the use of electric energy for house heating in Idaho in competition with coal is neither feasible nor practicable and would be unprofitable to any producers who might undertake to furnish the service; and, further, that so long as there remains a field for the use of electric energy as motive power, its use for house heating is extravagant and wasteful." These conclusions were reached by Commissioners A. L. Freehafer and George E. Erb, and were concurred in by Commissioner E. M. Sweeley, who was not a member of the commission when the investigation was begun.

City Sells $10,000 Garbage Grease.

Dayton, O.—Two cars of garbage grease, bringing a little more than $10,000, have been sold to the Fairbanks Soap company of St. Louis by the city garbage reduction plant, according to a statement by service director H. P. Martin. The cars will total about 120,000 pounds, at 9¾ cents per pound, and are to be delivered in February and March. The sales of by-products from the garbage plant netted the city $28,000 in 1916, 1917 and 1918, it was stated, in addition to paying operating expenses, sinking fund and the interest on the investment.

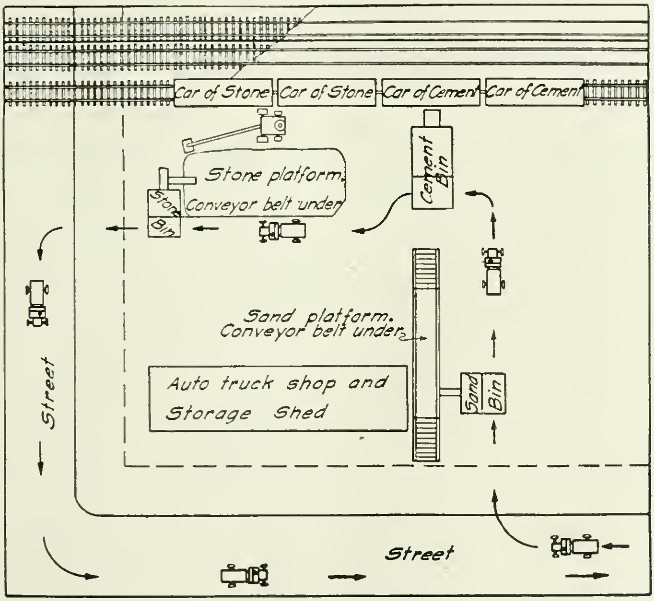
A set of four 48-inch corrugated culvert pipes 80 feet long were assembled complete on shore, fitted with automatic swing gates at one end, and quickly set in position in a drainage ditch between guyed piles by means of the boom of the floating dredge equipment that placed them under water 11 feet deep at low tide. This method utilized easily available equipment and avoided construction of an expensive and perhaps troublesome cofferdam.

A Systematized Concrete Paving Job

Bulk cement and aggregate delivered by railroad to storage plant equipped with electric unloading and conveying machinery. Materials loaded by gravity from bins to fleet of motor trucks transporting them a mile or more to mixer.

A job of concrete paving for which the construction details were carefully planned and carried out by the contractors, J. S. McLaughlin & Sons, of Red Oak, Ia., was carried out this summer at Spencer, Ia. The contract was for 95,865 square yards of concrete paving.

The work was about a mile from the railroad siding, and it was decided to store the materials in bins at the siding and haul them to the mixer on the job. As in so many other instances last year, scarcity of labor was anticipated and realized, and use was made to as great an extent as possible of mechanical equivalents for labor. The contractors also realized that with an extensive use of machinery there is likely to be breakdowns which will delay or tie up the entire work, and every effort was made to minimize these.



Sketch Showing Layout of Materials Plant and Route of Trucks Through the Plant for Loading.

While the subgrade was being prepared, three bins, one for cement, one for sand and one for stone, were being erected alongside the railroad siding. The cement was received in bulk, the stone by rail, and the sand was hauled from local sources in 5-ton motor trucks owned by the contractor. A shop was erected where quick repairs could be made of trucks and other parts of the equipment. The stone was removed from the gondola cars by a crane with a clamshell bucket, which deposited it in a wooden funnel, which in turn discharged it upon a conveyor belt and this dropped it into the buckets of a bucket elevator, by which the stone was lifted and discharged into the stone bin. The sand was dumped by the trucks into a funnel below the platform onto which they were run, and discharged into the sand bins in the same way as was the stone. On the underside of both sand and stone bins were measuring boxes through which the aggregate passed by gravity into the trucks, which were driven directly under the measuring boxes.

Bulk cement was delivered in freight cars, which were unloaded by a power-driven scoop, the cement carried to the top of the bin by bucket conveyors, and measured in a box on its way by gravity from the bin to the truck. Electric motors supplied the power for operating all of this apparatus.

These materials were hauled from this loading plant to the mixer by ten Ford trucks. Each truck first received a measured amount of sand, then of cement, and finally of stone and, traveling an average distance of a mile to the mixer, then discharged the entire material into the skip. This mixer had a capacity of 28 cubic feet per batch, and the trucks carried 24 cubic feet. The concrete was proportioned 1-2-3, giving a cement content of 1.7 barrels per cubic yard. Checking the amount of cement used in the first 13,000 square yards, it was found that this exceeded the amount specified by approximately 2 per cent.

The average run for a 10-hour day was 1,200 square yards of finished pavement, but as high as 1,580 square yards was made in a day; this including an integral curb along each side of the pavement, and the reinforcing of the pavement with steel rods. The roller and belt method of finishing was employed.

Including the loading plant, the paving gang and the trucks, 47 men in all were employed. The loading gang comprised one foreman, one mechanic, two men at the stone bin, two at the sand bin and three at the cement bin. Two machine operators handled the crane and there was a driver for each of the ten Ford trucks. The concrete gang included a foreman, two mixer operators, two men at the skip, two at the chute, three concrete spreaders or graders, two placing the steel reinforcing, five performing the finishing operations and two on the roller and belt. Five men were employed in covering the finished pavement with earth and keeping it wet, and removing the forms, and two helpers were assigned to miscellaneous duties.

The Santa Monica pier was built ten years ago with concrete piles, many of which have become so badly cracked and disintegrated that the engineers recommend replacing them with creosoted wood piles, caps and struts.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Firemen's Unionism Declared Illegal.

Pittsburgh, Pa.—It is illegal for any municipal employe to be affiliated with a labor union according to a report submitted to council by city solicitor C. A. O'Brien in response to a resolution requesting the information. It was said the city firemen belong to a union. In his legal opinion, solicitor O'Brien cited the instances of the recent strikes of police officers in Liverpool and Boston as furnishing most cogent of all arguments against the unionizing of these forces or "permitting them to have any outside affiliation or control which interfered with strict adherence to their duty to the public and obedience to the superiors charged wih the supreme obligation of maintaining public peace and order." He stated that the system established indicates that the legislature intended to make city firemen free from outside interference or influence.

Tuberculosis Hospital Not a Nuisance—Injunction Suit by Citizens.

(La.) Citizens and taxpayers have no right of action to enjoin city from creating a board of trustees for tuberculosis hospital, or putting a woman upon the board, or accepting donation for construction of building and maintenance of hospital, since they have no interest therein.—Le Bourgeois v. City of New Orleans, 82 So. 268.

Citizens and taxpayers in their capacity as such may sue to enjoin city from transferring funds and property of city to a private institution.—Id.

In suit to enjoin city from constructing and establishing tuberculosis hospital, evidence held to show that a well-kept tuberculosis hospital is not a menace to the health of the people living in its vicinity.—Id.

In suit to enjoin city from establishing and maintaining tuberculosis hospital, evidence held to show the hospital an imperative necessity.—Id.

A tuberculosis hospital 600 feet removed from a residence is not a nuisance to the people living in the residence.—Id.

Citizens and taxpayers in their capacity as such have no right of action to abate a public nuisance, but must sue in their individual capacity for impairment of indivdual rights.—Id.

Zoning—Validity of Ordinance—Prohibition of Obnoxious Occupations.

(Cal. App.) For the purpose of regulating occupations causing noise or offensive odors, city may divide its territorial limits into residence and business districts, and prohibit the keeping of a livery stable or corral for the keeping of horses, mules, etc., for hire, in residence district, and requiring a permit for maintenance thereof in business district, is not arbitrary.—Id.

In action by keeper of burros and mules for hire to enjoin city from enforcing ordinance prohibiting maintenance of corral for mules and burros in residence district, and requiring permit, for maintenance thereof in business district, it is not material that plaintiff may have kept his corral as clean as possible, and carried on his business in the most approved manner, or that it would be possible for one or more corrals to be maintained without an appreciable risk or peril to the health or safety of a community.—Id.

It is for the city's legislative body, clothed with police power by direct grant from the Constitution, to determine when and what regulations of a business are essential, and its determination will not be disturbed by the courts unless the regulation has no relation to the protection of health, safety, comfort, or well-being of the community, but is a clear invasion of personal or private rights under the guise of police regulation.—Id.

The exercise of police power by a city is not limited to the regulation of such things as already have become nuisances, or have been declared such by judgment of a court, but extends to everything expedient for the preservation of the safety, health, or comfort of the city's inhabitants. —Id.

A municipality has power by ordinance to divide its territorial limits into business and residence districts, and to prohibit in the residence district the maintenance of any corrals wherein mules and burros are kept for hire; the keeping of such corrals in a populous city or town being a nuisance.—Id.

Whenever a thing or act is of such a nature that it may become a nuisance, or may be injurious to the public health or obnoxious to the comfort of a community if not suppressed or regulated, the legislative body in the exercise of its police powers may make and enforce ordinances to regulate or prohibit it, although it may never have been obnoxious or injurious in the past.—Id.

Occupations which by the noise made in their pursuit or the odors they engender are offensive to the senses may be interdicted by law in the midst of populous communities on the general and rational principle that every person ought so to use his property as not to injure his neighbors, and that private interests must be made subservient to the general interest of the community.—Id.

"Western" Concrete Road Plant.

Catalog 45 of the Western Wheeled Scraper Co. is devoted to standard equipment for concrete road construction. It contains illustrations and descriptions of elevated wooden storage bins for aggregate and cement which are made in sections that can be shipped on flat cars and installed alongside the railroad track, where they are filled by means of a derrick or other elevating devices and deliver through bottom valves or gates to cars run on an industrial railway track laid on the surface of the ground under the bins.

Steel or wooden 1-yd. batch boxes for measuring and conveying, the sand, gravel and cement, are provided with bottom flaps held shut by chains passing up through the box, over the edge, and connected to outside levers locked in position by pins. One or two of these boxes are placed on each flat car, filled underneath the bin and hauled to position, where they are hoisted and swung above the charging hopper of the concrete mixer. The pins are then removed, releasing the levers and permitting the doors to open by gravity, discharging the contents of the buckets into the hopper and thus insuring rapid operation and exact proportion. Another type of batch box has the bottom flaps controlled by a second hoisting line.

The catalog also lists industrial tracks, flat cars, steel side-dump cars, and gives several diagrams with explanatory notes showing the arrangement and operation of track and equipment for handling aggregate and cement between storage and mixer and maintaining continuous operations with clearance between full and empty cars when the track is laid on subgrade or on a berm outside the roadway from where either one or two mixers are employed and when the concrete is laid towards or away from storage. Another diagram shows, a convenient arrangement of railroad siding, storage bins, box piles, unloading derricks and industrial railway.

Change of Grade—Benefits and Damages.

(N.Y.Sup.) The statutory provision requiring commissioners to ascertain the value of any benefits to the property in consequence of the alteration of the grade of the street does not confine the abutting landowner's damages to the condition immediately following the change of grade in its narrowest sense, but contemplates the condition existing when the work involving the alteration and change of grade is reasonably completed.—Rogers v. Village of Cato, 177 N. Y. S. 470.

NEWS OF THE SOCIETIES

Feb. 25.—NEW JERSEY SEWAGE WORKS ASSOCIATION. Annual meeting, Trenton, N. J. Secretary-treasurer, Frederick T. Parker, Guarantee Trust Bldg., Atlantic City, N. J.

Feb. 26-27. — MATERIAL HANDLING INDUSTRY. Annual Convention at New York. Secretary, Zenas W. Carter, 35 West 39th street.

Feb. 26-28. — SOUTHERN APPALACHIAN GOOD ROADS ASSOCIATION. Tenth Annual Meeting, Asheville, N. C. President, A. D. Williams, Parkersburg, W. Va.

March 8-9.—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. Annual Convention at French Lick, Ind. Secretary-Treasurer, L. R. Taylor, French Lick, Ind.

March 10.—VERMONT SOCIETY OF ENGINEERS. Meeting and convention at Burlington Vt. Secretary, George A. Reed, Montpelier, Vt.

March 16-18. — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Manhattan Building, Chicago.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

April 12-17.—UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17.—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth annual convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 18-21. — NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting secretary, S. A. Sewall, 29 West 39th street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st street, New York City.

Oct. 4-8.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln avenue, Valparaiso, Ind.

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American Association of Engineers.

Figures compiled by the American Association of Engineers from the reports sent in from the thirty-seven chapters and clubs who competed in the local publicity contest show that enough newspaper publicity has been obtained in the last four months to make up two complete editions of the Chicago Tribune. The contest closed on December 31.

The Globe-Miami, Ariz., chapter was the winner of the contest with a total of 438 column inches, or almost three solid pages, to its credit. The Toledo chapter was second with 430 column inches, and the Baltimore chapter third with 359. Butte, Mont., St. Louis, Cincinnati, and San Diego, Calif., held the next four places.

The contest was announced only late in August and the results were considerable for September, but the monthly amounts increased thereafter. A great deal of publicity was obtained which was not entered in the contest.

At the sixth annual convention of the association, to be held in St. Louis on May 10 and 11, chapters and clubs of the association will enter displays of publicity obtained since the 1919 convention.

Associated General Contractors of America.

The annual meeting was held at the Hotel Morrison in Chicago, Feb. 18 and 19, and it included a national conference Thursday afternoon, Feb. 19, that was divided into four sessions—namely, for building contractors, highway contractors, railroad contractors, and public works contractors. These four sessions were found to be especially interesting in Jurisdictional Awards, Estimating Expense, the Joint Labor Agreement, Contractor's Relations with State Highway Departments, the Reconstruction of Railroads and in the Jones-Reavis Bill to create a National Department of Public Works and the proposed budget system for Government expenditures.

During the convention special attention was paid to the labor question, which was considered from every standpoint for the purpose of formulating principles that will operate to simplify the construction industry and advance its economy and efficiency.

Another very important and timely subject is that of Contract Forms, the advantages and disadvantages of cost-plus contracts, and the part that the association will take in establishing standard forms.

In order to develop most potently a virile leadership for all general contractors' interests, the activities, results and future course of the association were presented and discussed and the ultimate form of organization was studied, with special reference to whether the Associated General Contractors of America shall become an organization of individual firms and corporations; an organization for stimulating and assisting local chapters of general contractors; a federation of national and regional association of general contractors interested in different types of construction; or whether it shall adopt the ideal plan of a great national service including all the factors in one association. These questions were thoroughly discussed and the revised constitution and by-laws ratified.

Important reports from the committees on labor and on contracts and on other current subjects were presented, and good fellowship was promoted by the smoker and entertainment, Feb. 18, and the annual dinner, Feb. 19.

Indiana Engineering Society.

At the annual meeting in January the following officers were elected: President, Wm. T. Titus, Indianapolis; vice-president, O. C. Ross, Indianapolis; secretary, Charles Brossman, Indianapolis. Trustees: D. D. Ewing, Lafayette; A. P. Melton, Gary; John W. Fulwider, Lebanon; Frank C. Wagner, Terre Haute; Edwin S. Pearse, Indianapolis.

American Institute of Engineers.

The Detroit Chapter has elected P. W. Keating, president; J. S. Lillie, first vice-president; P. C. Handyside, second vice-president; E. L. Brandt, secretary, and J. T. Southern, treasurer.

Engineering Institute of Canada.

The thirty-fourth annual meeting was held in Montreal, Jan. 27-29, 650 present. It was announced that the number of its branches has been increased to eighteen, all of which are prospering, with a total membership of 3,657 on Dec. 31. The Gzowski Medal was awarded to Phelps Johnson, George H. Duggan and George F. Porter for their paper on the "Design and Construction of the Quebec Bridge." Officers for 1920: President, R. A. Ross, Montreal; vice-president, Brigadier-General C. H. Mitchell, Toronto, and W. G. Chase, Winnipeg; directors: F. B. Brown and Julian C. Smith, Montreal; A. R. Decary, Quebec; F A. Bowman, Halifax; J. B. Challies, Ottawa; E. R. Gray, Hamilton; Guy C. Dunn and B. S. McKenzie, Winnipeg; J. R. Macredie, Moose Jaw; George W. Craig, Calgary, and H. M. Burwell, Vancouver.

The American Road Builders Association.

In the 17th annual convention at Louisville, Feb. 9-13, the principal papers presented and subjects discussed included:

Co-operation between Engineers and Contractors in the Execution of Highway Programs.

Modern Plant and Equipment for Highway Construction.

Status of State Aid to Counties, and Its Future Development.

Should the Township and the District Board be Abolished as Road Construction and Maintenance Units?

Is State Supervision of the Construction and Maintenance of All Highways Desirable?

What Part of the Total Cost of Highway Construction and Maintenance Should the Motor Vehicle Be Expected to Bear?

Factors Which Will Limit Highway Construction During the Coming Season: (a) Car Supply and What Can Be Done to Overcome the Shortage? (b) Materials. The Development of Local Supplies and Increasing the Output of Existing Plants; (c) Labor, How Can Supply and Efficiency Be Increased?

The Fundamentals of Early Highway Construction, and Are We Neglecting Them?

What Are the Fundamentals of Modern Highway Construction?

New Highway Tests Being Made by the Bureau of Public Roads.

For What Grade of Construction Should Federal Aid Funds Be Expended?

New Developments in Proper Construction of and Bad Practice Which Should Be Eliminated in Concrete, Brick, Granite and Wood Block, Bituminous Penetration, Bituminous Mixed and Surface-Treated Macadam and Gravel Pavements.

Southern Appalachian Good Roads Association.

The convention will be held in Asheville, N. C., Feb. 26-27-28, and will give special attention to a state wide system of roads especially adopted for automobiles and heavy motor trucks. Gov. Thomas W. Bickett has made appointment of the following official delegates:

A. P. Lindsey, Gastonia; William Bradford, Huntersville; Eugene Transon, Sparta; Bennehan Cameron, Stagville; Bion Butler, Southern Pines; J. M. Boyette, Albemarle; N. B. Mills, Statesville; A. S. Patterson, Bryson City; W. T. Lindsey, Tryon; R. C. Mensies, Hickory; R. L. Ballou, Jefferson; J. W. Ragland, Newland.

National Association of Railroad Tie Producers.

The first annual convention was held at the Sherman Hotel, Chicago, February 12 and 13 and was presided over by President J. W. Fristoe. Routine business was transacted, official reports were made, officers were elected for the coming year, and the program was concluded by a formal banquet.

PERSONALS.

Newell, Professor F. H., president of the American Association of Engineers, has been appointed a member of the United States Chamber of Commerce Committee to consider a local Chamber of Commerce referendum of the National Department of Public Works movement.

Mr. Hall, of the Westinghouse Electric and Manufacturing Company, lectured recently in Detroit to the American Institute of Electrical Engineers and to members of the American Society of Mechanical Engineers on the design and application of electrical equipment for submarines, illustrating the subject with lantern slides.

Bass, A. S. S., Professor F. H., of the University of Minnesota, led a discussion on city planning at the annual meeting of the Minneapolis Engineering Club, January 19.

Fowler, Charles Evans, has opened an office in Detroit as chief engineer of the $28,000,000 Detroit suspension bridge about to be built there.

Carntherz, W. S., has been appointed county highway engineer of Sacramento County, California.

Winslow, George R., has been appointed division engineer of the California Highway Commission at Sacramento.

Thompson, Carroll R., has been promoted from principal assistant engineer to assistant director of the department of wharves, docks and ferries, Philadelphia.

Graff, Major B. H., has been appointed division engineer of the first district of the Georgia State Highway Commission.

McMillan, E. H., has been appointed road engineer for Gilmer County, West Virginia.

Platt, J. F., formerly of the Chicago, Milwaukee and St. Paul railroad has been promoted to chief engineer of the Wyoming State Highway Department.

Parker, Arthur, has been made chief engineer of Cheyenne, Wyoming.

Slade, Green, has been appointed highway engineer 10th Congressional District, Ga., with headquarters in Augusta.

Koller, Orion, will continue alone the business of the engineering firm of Koller & Conrad, Wheeling, W. Va.

Conrad, Harry, has been appointed City Engineer, Wheeling, W. Va.

West, C. W., has been appointed engineer for the Houghton Co. Road Comm., Virginia.

Garrett, Geo., has been appointed city engineer, La Grange, Ore.

McCluskey, N. M., has been appointed highway engineer of the Clovis District, New Mexico.

Jacobson, Robt. T., has been appointed city engineer, Fargo, N. D.

Jones, D. W., has resigned the position of engineer of the Clovis Highway District, N. M., to accept a position with the Clovis Chamber of Commerce.

Anders, Frank L., recently city engineer, Fargo, N. D., has engaged in consulting practice.

Neslen, C. Clarence, commissioner of water supply and water works, Salt Lake City, Utah, retains the same position in the reorganization of the Board of Commissioners.

Bock, E. A., Mayor of Salt Lake City, Utah, has been made commissioner of Public Safety.

Greene, Herman H., has been made commissioner of Public Affairs and Finance, Salt Lake City, Utah.

Crabbe, A. H., has been made commissioner of Park and Public Property, Salt Lake City, Utah.

Burton, T. T., has been made commissioner of Streets and Public Improvements, Salt Lake City, Utah.

McKay, Capt. W. Johnston, City Manager of Newburg, N. Y., has requested his salary be reduced from $6,000 to $5,000 and the difference distributed among lower paid city officials.

Vars, Alexander W., has resigned as town surveyor of Westfield and has been appointed city engineer of Plainfield, N. J.

Collins, Wesley C., has been appointed surveyor and clerk of the purchasing board of Westfield, N. J. Mr. Collins is a graduate engineer with several years' practical experience on the Central Railroad of New Jersey in sewer construction in Westfield and as principal assistant in the engineering office of A. W. Vars, Plainfield.

Pilcher, Lewis E., has been appointed architect of New York State and the New York State Association of Builders has endorsed the governor's choice.

Davis, E. H., has been appointed chief engineer of the sixth district, Georgia Highway Department.

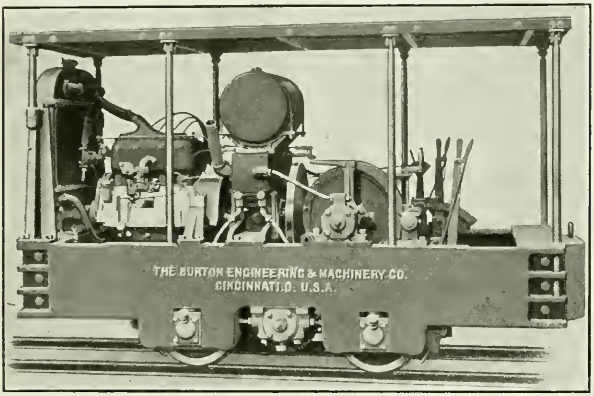
Marble, Arthur I., has resigned as city engineer of Lawrence, Mass.

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

Burton Gasoline Locomotive.

This 3½-ton, class D locomotive is 10 feet 5 inches long, 6 feet 5 inches high, has a 39-inch wheel base and weighs 7,000 pounds. It has a draw bar pull of 1,400 pounds at 5 miles per hour and 700 pounds at 10 miles per hour. It can be operated either by gasolene or kerosene, consuming from 5 to 10 gallons per hour, and is designed and constructed with special reference to free access and simplicity of parts.



NARROW GAGE GASOLENE LOCOMOTIVE READY FOR SERVICE.

Among the special features emphasized by the manufacturers are the Herschell-Spillman motor with four 3½-inch cylinders and 5-inch stroke, rated at 25 h. p. for 1,000 r. p. m., and at 41 h. p. for 2,000 r. p. m.; cooling system with a honey comb core construction radiator supported by special spring hangers to protect it from shock and located at the front of the locomotive and provided with a special fan with reversible blades, giving a positive cooling whether the locomotive is running forward or backward; spur friction with heavy bearings; cast iron brake shoes operated by toggle joint mechanism and equalizing on all four wheels, and operation by an easily accessible hand lever. Finest material throughout.

Brockway Motor Trucks.

The new handsomely illustrated catalog of these trucks, which are made in 1½, 2½, 3½ and 5-ton sizes with worm drives, gives photographs of some of their special parts, of different types of body and of large groups of trucks parked ready for shipment for United States cantonments and other destinations.

Special stress is laid on the manufacture of individual parts by the maker with the combination of the best specialties like motors, axles and other highly developed parts that have great recognized merits.

Four-Wheel-Drive Tractors,

The four-wheel-drive tractors manufactured by the Topp-Stewart Co. are rated from 30 to 45 h. p., have a 108-inch wheel base, 11-foot turning radius, speed of 4½, 2½ and 1¾ miles per hour and weigh 7,500 pounds. They are guaranteed to handle four fourteen inch bottom plows and to handle a 10-foot blade road grader under normal conditions.

Special features emphasized by the manufacturers include differential and drive shaft housing, rigid with axles; two or four wheel steer; power applied to rims of four wheels by enclosed alloy steel pinion and cut gears; tubular annealed cast steel axles; roller bearings, and even distribution of weight on all four wheels, giving maximum traction value.

Hydraulic Hoist and Truck Dumper

The Horizontal Hydraulic Hoist Co. has put on the market an improved equipment consisting of horizontal hydraulic hoists and dump bodies for motor trucks. The complete outfit includes a horizontal hydraulic cylinder and pump with connections mounted on a structural steel frame with proper attachments and with a clutch that drives the pump mechanism from the truck propeller shaft, and a truck body having a double acting tail gate, hinged at both top and bottom, and removable side boards equipped with stakes set in pockets.

The horizontal hydraulic hoist is installed entirely below the truck body, thus avoiding any obstruction of loading space on the chassis. The leverage is such as to make the cylinder pressure nearly constant throughout the entire stroke, and the manner of mounting assures the distribution of the hoisting stress for a distance of 5 feet along the truck frame, over the rear springs and axle, so that no concentrated hoisting stress is imposed on the frame. No portion of the hoisting mechanism extends below the truck frames or interferes with brake rods and other truck mechanism. The control is very simple and is governed by setting the lever at raising, holding or lowering positions. The truck body can be raised or tilted or lowered while the pump is in operation, or the pump can be stopped and held in any position that may be desired while raising or lowering.

Willite Pavement

The Willite Road Construction Co. of America has issued a small pamphlet of Armor Plate roads or hard top highways, surfaced with Willite, which in recent years has been laid in several states and in Canada. Willite pavement is a two-course construction made chiefly of local materials and containing from 80 to 85 per cent of aggregate and from ¼ of 1 per cent to ½ of 1 per cent of metallic sulphate for tempering the asphaltic paving cement forming the wearing surface which may be prepared in any paving plant suitable for making asphaltic mixtures, thus eliminating the necessity for special equipment. No binder course is used and a pavement consisting of 3-inch base and 2-inch wearing surface, has a total weight of 500 pounds per sq. yd. of surface in comparison with 632 pounds to 1,245 pounds for various other kinds of pavements mentioned with total thicknesses of 6 to 13 inches. It is claimed that Willite is cheaper than asphalt block or brick pavements on concrete base; that it will not soften or harden or become brittle; is not slippery; is almost completely waterproof; can be used immediately after laying; and is very durable.

"Western" Concrete Road Plant.

Catalog 45 of the Western Wheeled Scraper Co. is devoted to standard equipment for concrete road construction. It contains illustrations and descriptions of elevated wooden storage bins for aggregate and cement, which are made in sections that can be shipped on flat cars and installed alongside the railroad track, where they are filled by means of a derrick or other elevating devices, and deliver through bottom valves or gates to cars run on an industrial railway track laid on the surface of the ground under the bins.

Steel or wooden 1-yd. batch boxes for measuring and conveying the sand, gravel and cement are provided with bottom flaps, held shut by chains passing up through the box, over the edge and connected to outside levers locked in position by pins. One or two of these boxes are placed on each flat car, filled underneath the bin and hauled to position, where they are hoisted and swung above the charging hopper of the concrete mixer. The pins are then removed, releasing the levers and permitting the doors to open by gravity, discharging the contents of the buckets into the hopper and thus insuring rapid operation and exact proportion. Another type of batch box has the bottom flaps controlled by a second hoisting line.

The catalog also lists industrial tracks, flat cars, steel side-dump cars, and gives several diagrams with explanatory notes showing the arrangement and operation of track and equipment for handling aggregate and cement between storage and mixer and maintaining continuous operations, with clearance between full and empty cars when the track is laid on sub-grade or on a berm outside the roadway, from where either one or two mixers are employed, and when the concrete is laid toward or away from storage. Another diagram shows a convenient arrangement of railroad siding, storage bins, box piles, unloading derricks and industrial railway.

Self-Heating Asphalt Smoother

The Hauck Mfg. Co. has just placed on the market a new type, self heating asphalt smoothing iron that, it is claimed, reduces the cost of smoothing by 80 per cent. It is a self-contained tool, not much more bulky than the ordinary furnace heated smoother, and has a weight of 60 pounds, ample for pressure requirements. It is very compact, has the kerosene oil burning device protected by a shield, not shown in the engraving, and can be operated by a single man who controls the flame by a regulator just forward of the main handle.

OIL BURNING SELF HEATING SMOOTHER.

The handle carries a 1½-gallon tank equipped with hand pump, filler plug, gage and kerosene burner with an oil needle valve and strainer. It can be operated by any laborer, thus saving the time of two men, and need not be removed from the surface of the asphalt until the smoothing of the entire area is completed. Its use eliminates the disagreeable wood fire wagon and the transportation of the iron from it to the pavement and it saves from 60 to 75 per cent in the cost of fuel.

INDUSTRIAL NEWS

Permanent Construction Machinery Fair.

An innovation in the sale and demonstration of engineering construction plants and equipment that should be of considerable value and importance both to manufacturers dealers and consumers, has been inaugurated at Center and Walker streets, New York City, by the recent opening, by the Allied Machinery Company of America, of a permanent fair for the exhibition of standard machines.

Such items as locomotives, steam engines, motors, trench excavators, road rollers, shovels, hoisting engines, electrical and gasolene equipment and even hand tools, are displayed on one floor, while on the next floor there are located the business offices of the fifteen dealers already represented in this association. The exhibition is intended to promote both foreign and domestic sales, and is supplemented by provisions for demonstration of the actual operation of the plants by experts, who are not only able to explain their mechanical action and construction, but are also qualified to anaylze the construction problems of visitors and to suggest to them desirable plans for the selection and arrangements of plants and for a proper co-ordination in construction, maintenance and operation. This should enable purchasers not only to secure the most durable and efficient machinery, but to exercise intelligent discrimination in purchasing that which is most likely to be suitable for future needs and to be adaptable for modified service. This feature will be a rational development of the practice, already inaugurated by some leading manufacturers, of designing the installation and auxiliaries for customers who purchase quantities of their plant for important service. At a formal luncheon given at the opening of the exhibit on January 27, addresses were made by J. W. Alexander, secretary of commerce; G. C. Redfield, former secretary of commerce; Senator Edge, W. L. Saunders and G. E. Smith.

The following firms are already participating in this exhibit: Austin Manufacturing Co., Austin Western Road Machinery Co., Barber Greene Co., Carbic Manufacturing Co., C. H. and E. Manufacturing Co., Inc., Clyde Iron Works, Cook Motor Co., A. B. Farquhar Co., Ltd., Hydraulic Pressed Steel Co., Lakewood Engineering Co., Parsons Co., Sterling Wheelbarrow Co., Thew Automatic Shovel Co., Western Wheeled Scraper Co., Wyoming Shovel Works.

A Durable Smith Mixer.

James Horrabin & Company, Des Moines, have recently purchased from the Pierson Construction Company a Smith Power Concrete Mixing machine, which has been in constant operation for about 18 years. This machine is one of the first ever built by T. L. Smith, founder of the manufacturing compay, and that it should still be not only usable, but salable is a sufficient comment on its quality.

The American-La France Fire Engine Company, Inc., sold during the month of January thirty-nine engines, water towers, service truck, combinations and triple combinations and Brockway cars to thirty-nine cities in eighteen states.

The Bureau of Highways, Philadelphia, contemplates the establishment of a $150,000 asphalt plant for street repair work.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, FEBRUARY 28, 1920 No. 7

Bridge Arch Center Trusses

By C. D. McArthur

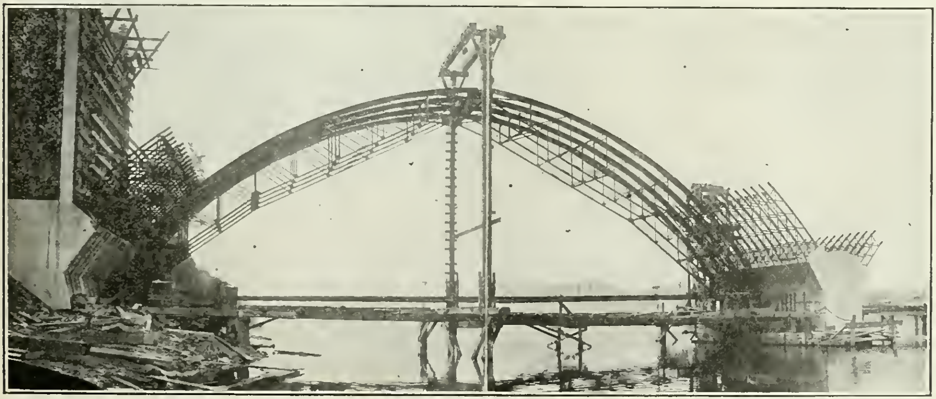
Concrete barrel and rib arches for bridge spans are advantageously carried on falsework truss centers for spans of more than 25 or 30 feet, especially if very high or over spaces where obstructions are objectionable. Steel trusses of standard designs and fabrication are increasingly economical as costs of labor and materials rise. They are especially so for long or multiple spans and heavy loads. They are safer, stiffer, more accurate and reliable and more easily and cheaply handled and have much wider range of dimensions. They can be rented or bought and salvaged.

The bridge arch centers here considered are the full length or long span temporary truss supports used for the construction of masonry or concrete arches and removed after the latter are swung. Arch spans of less than 20 or 25 feet are not considered because they are comparatively few and unimportant, and usually built under conditions that permit any kind of temporary supports to be adopted, utilizing local conditions and materials according to the convenience of the builder without much regard to theoretical consideration or to economical advantages and disadvantages that become important on larger and more numerous structures.

CHARACTER OF ARCH SPANS.

Bridge arches, both for railroad and highway traffic are at present constructed almost always of concrete, usually with reinforcement, although they are occasionally built of stone or of a combination of concrete and paving stone, and very rarely of brick. In any event, they require during construction to be supported on temporary platforms to correspond with the intrados of the arch and are designed to afford strength and rigidity and to be capable of removal in such a way as to transfer the load of the permanent structure to its own elements in a satisfactory manner.

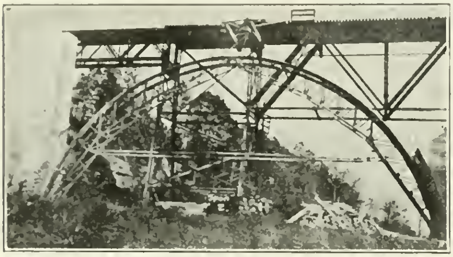
In proportion as the openings become higher



ARCH CENTER TRUSSES ERECTED FOR LONG SPAN OF MENTONNE, N. Y., BRIDGE, AND REINFORCEMENT STEEL ASSEMBLED AT SKEWBACKS.

and wider the difficulty and expense of providing temporary supports for the permanent structure are increased and it generally becomes desirable to use trusses known as centres, to support the lagging on which the elements of the permanent arch are assembled.

Concrete arch spans are of all lengths up to 200 feet with occasional examples up to a practical maximum of 300 feet as is illustrated by the Key bridge now being built at Washington, D. C. Still greater lengths have rarely been designed and a very few have been built but the weight and stresses become so great that each of them is a special problem requiring special treatment and subject to practical consideration that vary greatly with local conditions and eliminate uniformity of practise in the matter of centers.



ROANOKE BRIDGE TRUSS CENTERS ERECTED READY FOR LAGGING.

The general consideration of making the cost of the substructure and superstructure equal in the interests of economy; the requirements for waterways, clearance underneath and grade overhead, together with aesthetic considerations and established precedent, operate to keep the great majority of arch bridge spans in this country between lengths of about 40 feet and 200 feet so that an average of those requiring truss centres are considered to have a span of approximately 120 feet. When the height of the opening is small and it is permissible to obstruct it with falsework and shoring, the span may be supported during construction at so many intermediate points that the use of trusses is unnecessary and cheaper results can be obtained without them. These cases are however comparatively few and will be here ignored, attention being fixed solely on the cases where full length temporary spans are required for construction purposes.

WOODEN TRUSSES.

Where the spans are few and short, and the permanent structure is very light, especially where there is little or no duplication of spans, and perhaps in some cases where moderate length spans have to be constructed in very remote or inaccessible localities; where timber is plentiful and where great delay and expense would be involved in shipping steel trusses; wooden trusses may be preferable for spans up to about 75 feet. They can be built at the site with ordinary tools and mechanics but they are more difficult to design and adjust, are heavier for equal strength, are subject to injury in moving, taking down and re-assembling, are inflammable and may absorb large quantities of water causing them to become swelled and distorted. They are not adapted to very heavy stresses or extremely accurate operations.

STEEL TRUSSES.

Steel trusses are indispensible for very long spans and great weights, and possess many practical and theoretical advantages over wooden trusses for moderate length spans in which the latter might be used.

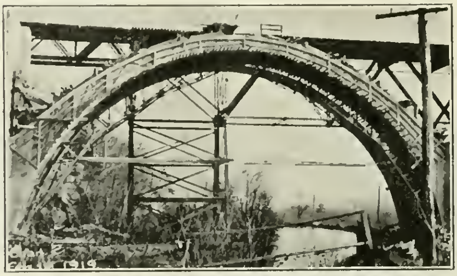
Steel is a much safer and more reliable material than wood and can be designed and fabricated with far greater precision, thus eliminating a large factor of uncertainty and expense. The steel trusses are designed by experts thoroughly familiar with theoretical and practical requirements, are built of standard materials and fabricated in special shops. They are accurately proportioned and properly detailed according to standard structural steel specifications for stresses, materials and workmanship, and are therefore thoroughly reliable without waste or extravagance.

They are really tools of precision, economically designed and applied, and specialized according to the particular requirements of each case.

They are much lighter and stiffer than wooden trusses of equivalent strength; they are more easily handled, assembled and erected; they are not subject to injury or deterioration in shipment, handling or storage; they are more quickly, easily, and safely erected, taken down, re-assembled and shifted; they are adapted for economical and efficient bracing and their use relieves the contractor of any anxiety regarding safety and efficiency.

COMPARATIVE COSTS.

Where the length or the weight of the arch is very great and it is necessary to maintain a clear opening underneath, or on account of flood conditions, there is often no alternative to the steel truss at any price, and even where the use of wooden trusses under such conditions is within the limits of possibility, their cost becomes too excessive for serious consideration.



FORMS IN POSITION ON STEEL CENTERS FOR ROANOKE BRIDGE.

In almost all other cases where there is a possibility of choice between wood and steel the latter is more economical, regardless of all other advantages, in direct proportion to the re-use that is practicable. Formerly if a steel truss could be moved and used over again four times, it was assumed to be cheaper than a wooden truss that might cost less initially but would require renewal or repairing and be more difficult to handle. With the present increased cost of timber and labor, it is considered that steel trusses can be used as economically or more so than wood if they can be used only twice.

To accomplish this, it is not necessary that the spans should be exact duplicates because considerable variation of span can be met with the same trusses and inexpensive alterations easily effected. Trusses may also be re-used in the same span when the width of the latter is great and the trusses are shifted transversely during successive stages of construction.

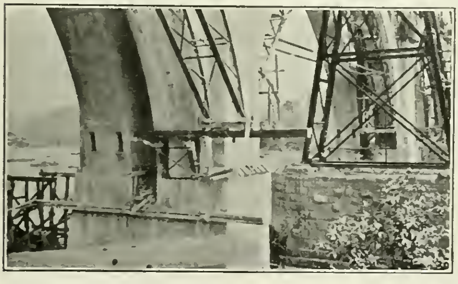
RENTAL AND SALVAGE.

At present steel trusses are generally rented by the manufacturer to the contractor at a price which approximates about $1.50 per yd. of concrete in the bridge superstructure including roadways, spandrel walls and other concrete above the springing line, while the corresponding cost for wooden trusses is estimated at about $4 per cu. yd. of concrete.

The trusses are usually designed especially for the work on which they are used and are then returned to the fabricating shops where there are special facilities for cutting them up into high grade scrap which is stored, sometimes for months, until it can be sold in the most favorable market, whereas, if the contractor purchases the trusses outright, he must either store them for a long time on the possible chance of an opportunity to use them in future work usually involving radical changes in them, or he must sell them for scrap and cannot usually hold them so long or sell them so advantageously as the manufacturer.

DESIGN.

Arch center trusses are of simple design proportioned for the maximum dead load of the permanent structure plus all erection stresses, and for the unbalanced erection loads produced by unequal and unsymmetrical loading during construction. They always have top chords curved approximately to fit the intrados of the arch but the outline of the remainder of the truss and the arrangement of the web members may vary to suit special requirements or the fancy of the designer.



ROANOKE BRIDGE ARCH CENTER TRUSSES DISPLACED TRANSVERSELY READY FOR LONGITUDINAL MOVEMENT TO NEXT SPAN.

A large majority of the trusses, however, are of a standard type, each span being composed of two symmetrical duplicate units connected at the crown of the arch and having the ends of their top chords connected by straight inclined lower chords reaching from crown to skewbacks and intermediately connected to the top chord by radial and inclined members. The lower end of one of these units is connected to the lower end of the other by an adjustable horizontal tension member pin-connected to the skewbacks and frequently supported from the crown by a tension member at the middle point. Sometimes these trusses are pin-connected together at the crown of the arch but even if not, the flexibility of construction is such as to generally make it equivalents to a one-hinge arch.

BRIDGE AT ROANOKE, VA., CONCRETED ON STEEL TRUSSED CENTERS.

The top and bottom chords have T-shape cross sections made with pairs of angles and vertical web plates. The web members are made with one or two pairs of angles riveted to gusset plates. Trusses 40 feet long or less are generally riveted up complete at the shops and shipped as units. Longer spans are shipped in sections as large as can be advantageously transported and handled by the contractors. With the exception of the pin connections mentioned, all field joints and splices are made with finished bolts in reamed holes and all other joints and connections are shop riveted.

For any span multiple trusses are always required and are generally spaced about 5 feet apart on centres transversely and connected together with vertical transverse bracing and with diagonal laterals, all of which may be either compression or tension members, the latter generally having screw ends or turnbuckle adjustments.

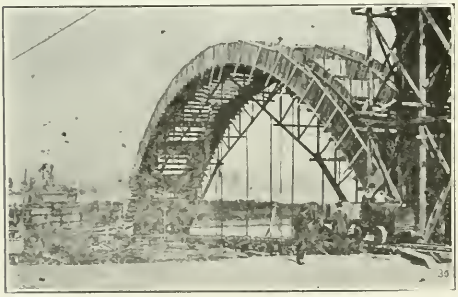
The weights of the spans vary of course according to the dimensions of the permanent arches and single trusses weigh from about 2,000 pounds for a 25-foot span to 130,000 pounds for a 200-foot span, depending entirely upon the load. A maximum weight of a single truss section as shipped from the fabricating shop is about 10,000 pounds.

ERECTING AND HANDLING TRUSSES.

Spans up to about 75 feet in length are generally assembled and connected complete in a horizontal plane on the ground, and lifted to their required position by derricks, gin poles, locomotive derricks, cableways, or any other hoisting plant that the contractor has installed for general construction purposes. Spans of more than 75 feet can generally be erected in two sections handled simultaneously by the derricks or other apparatus that hold them in position until spliced at the field connections making them self supporting. Still longer trusses may be similarly erected in three sections, the end sections being put in position and maintained there while the center section is hoisted and connected to them. As fast as the trusses are erected they should be braced to each other or to some stable objects, or should be carefully guyed until two or more trusses are thoroughly braced together with their transverse and lateral members, making an independently stable structure.

Very long or heavy spans may, if necessary, be erected piecemeal on falsework similar to that for the erection of steel truss bridges, but this method is seldom necessary and then only for extreme dimensions.

In the construction of very wide arch bridges, particularly where they replace old bridges on the same alignment, it is frequently desirable to complete one longitudinal half of the bridge from end to end before commencing the second half, but, if there are only a few good size spans of a new bridge, it is generally economical to build one longitudinal half of one or two spans and then build the second half of the same span or spans before commencing other spans of the same structure. Steel truss centers are therefore provided for a certain number of semi-spans and may be shifted both transversely and longitudinally as the work advances.



FALSEWORK TRUSSES SUPPORTING FORMS FOR RIBS AND STRUTS OF BROADWAY BRIDGE OVER ARKANSAS RIVER AT FORT SMITH, ARK.

They are usually shifted transversely by moving horizontally the entire group braced together as a single unit for each span. To accomplish this they are lowered sufficiently to clear the intrados of the finished arch and are pushed across on a horizontal track with roller bearings or on greased skids. They may be hauled by tackles at each end, forced over by jacks, or pinched along by hand, or by a combination of these methods.

For longitudinal movements they are generaly stripped of the lagging, transverse bracing and laterals removed, and the trusses if of short or of moderate spans, handled as units from one span to the next, or if larger are disconnected into the original shipping sections which are handled in any convenient manner.

The trusses are provided at the lower ends with shoes or pedestals having horizontal base plates that take bearing, during service, on pairs of folding wedges supported on the piers, abutments, or falsework. They are easily set and adjusted to give them the exact elevation required. The length of span is accurately determined and secured by the adjustments in the bottom chords that usually provide for several inches difference in length with corresponding rise and fall of the top chords.

On important work the trusses are designed to have, when first erected and not loaded, a slightly greater depth than the required rise of the completed arch. The compression of the top chord when fully loaded is sufficient to bring it very closely to the exact curve corresponding to that of the intrados. During construction, while the trusses are partly or unequally loaded or when they are subjected to great inequalities of temperature, as when one is exposed to sunshine and another is in shade, there may be considerable distortion or deflection amounting to an inch or more that disappears with uniform loading and temperature.

When the concrete is sufficiently hardened, the wedges supporting the ends of the trusses are slacked off and adjustments screwed up, springing the trusses so that the bottom chords are easily detached from the concrete and lowered to position for removal or transverse displacement.

Trusses can usually be modified to suit spans a few feet longer or shorter than those for which they were designed, by the simple expedient of lengthening or shortening the end panels which can be generally done by changing a very few members, new ones being supplied if necessary by the manufacturers. If there is any material difference in the curve of the intrados it can generally be provided for by inserting fillers between the curved top chords of the trusses and the lagging. In this way one set of trusses are frequently made to suffice for three different span lengths and are made the exact length for the intermediate span, extended for the longer, and shortened for the smallest one.

Rational Highway Construction

Lewis S. Sadler, State Highway Commissioner of Pennsylvania in a recent address to the York County Commissioners, urged them to pay special attention to heavy hauling in planning their program for the expenditure of $2,500,000 road money. He pointed out that although the absence of trucks might permit a saving of $20,000 a mile on road building, the trucks have come to stay and must be provided for in increasing numbers, and that the roads should be built so as to be serviceable 365 days in the year, and laid out in such a manner that the entire county will benefit rather than individuals. It was also desirable to consider the adequacy of 15-foot roads in some places where travel was light, and very heavy construction may be unnecessary.

Pavement repairs in Boston last year exceeded any previous year and the condition of the streets was such that $10,000,000 could be advantageously spent on them during the next few years.

$200,000 to Advance Construction Organization

Great results possible from the ably developed plans, preparations, resources and official development of the Associated General Contractors of America as a powerful and beneficent national federation of strong and reputable individuals and associations responsible for a large proportion of public construction in this country.

The strong progressive action of the Associated General Contractors of America at their annual meeting in Chicago last week, is an index of the attitude of large construction interests in this country and the readiness with which the individuals associated with them, devote their time, labor and money to improvements and organization that tend to develop and safeguard engineering construction throughout this whole country. Members present subscribed $200,000 in less than one hour, for promoting the great aims of this splendid engine of national prosperity. The magnitude and purpose of their efforts are best set forth in the preamble to their constitution which was adopted as an amendment as follows:

The special aims of this Association are:

(a) To make membership in the Association a reasonable assurance to the public of the skill, honesty and responsibility of its members, by requiring that those admitted to membership shall have established an honorable reputation on these three fundamental points, and by making continuance in this membership depend upon fair dealings between members and between members and the public.

(b) To provide methods and means whereby members may avail themselves of the greater power of combined effort through the Association, acting as an authoritative body, in demanding and securing just and honorable dealings from the public whom they serve.

(c) To secure uniformity of action among the individuals forming the Association upon the general principles herein set forth, and upon such other principles as may be decided upon, from time to time, as best for the good of the industry as a whole.

Other amendment classify the membership and fix a sliding scale of views differentiated according to the nature and amount of business executed.

ARTICLE III—MEMBERSHIP.

Section I. Membership in the Associated General Contractors of America may be of three classes: (1) Individual, (2) Associated Organization, (3) Honorary.

Section 2. Only General Contractors, either individuals, firms or corporations, who have been engaged for at least two (2) years in general contracting, prior to applying for membership in this Association and who have established a reputation for skill, honesty, and responsibility, shall be eligible for individual membership. They must also undertake work in its entirety partly, at least, with their own constructing forces.

Section 3. Only organizations of General Contractors shall be eligible to membership as Associated Organizations. Only such members of Associated Organizations as fullfill the above requirements for individual membership shall have voting representation in this Association.

Section 4. The Executive Board may elect as Honorary Members individuals, firms or corporations, who have executed some unusual and exceptional construction work or who have performed distinguished service for the nation or for this Association, whom the Association shall deem worthy of the distinction. Honorary members shall be exempt from assessments of dues.

ARTICLE VI.—DUES.

Section 1. The dues of the Association shall be for each individual, firm or corporation, as follows:

	Members Whose Business in the Previous Year Exceeded	But Was Less Than	Dues per Annum
Class A	$2,000,000	$.........	$250.00
Class B	1,000,000	2,000,000	150.00
Class C	500,000	1,000,000	100.00
Class D	250,000	500,000	50.00
Class E	....	250,000	25.00

Section 2. The dues of Associated Organizations shall be twenty per cent (20%) of their annual income from dues with a minimum payment of twenty-five dollars ($25.00) and a maximum payment of one hundred dollars ($100.00) for each one of their individual, firm or corporation members.

Another important amendment provides for the enlargement of the Executive Board to consist of president, three vice-presidents, a treasurer, 12 directors and the three living past presidents most recently elected.

An Advisory Board of seven members was created that consists of the retiring officers and directors and such others (not necessarily members) as may be selected by the Board. Members of the Advisory Board shall act as alternates at the meetings of the Board in the absence of Directors, only, however, when they are members of the Associated General Contractors of America. They shall hold office for one year.

The by-laws provide that there shall be created Members' Divisions, each of which shall be devoted to the promotion of the interests of a special type of construction. Each division shall have its own Chairman and Vice-Chairman and such Special Committees as are necessary. Action taken by any Division to be official must be approved by the Executive Board.

There shall be created a Building Contractors'

Division of the Associated General Contractors.

There shall be created a Highway Contractors' Division of the Associated General Contractors.

There shall be created a Railroad Contractors' Division of the Associated General Contractors.

There shall be created a Public Works Division of the Associated General Contractors.

Provision was also made for sixteen important standing committees, namely, executive.

The standing Committees of the Association shall be:

Executive
Finance
Auditing
Nominating
Membership
Legislative
Labor
Methods
Contracts
Codes
Ethics
Construction Development
Annual Convention
Transportation
Insurance and Bonds.
Publicity

Subjects for investigation and report by any of the Committees may be recommended by any member of the Association to the Board, to the Chairman of any Committee, or to the Secretary who shall refer them to the Board. The Board shall then refer them to the proper committee for investigation and report with recommendations. Ordinarily action following investigation and report shall not be taken by any committee without the approval of the Board; and no action taken by any committee shall be official without such approval, thus insuring deliberate action.

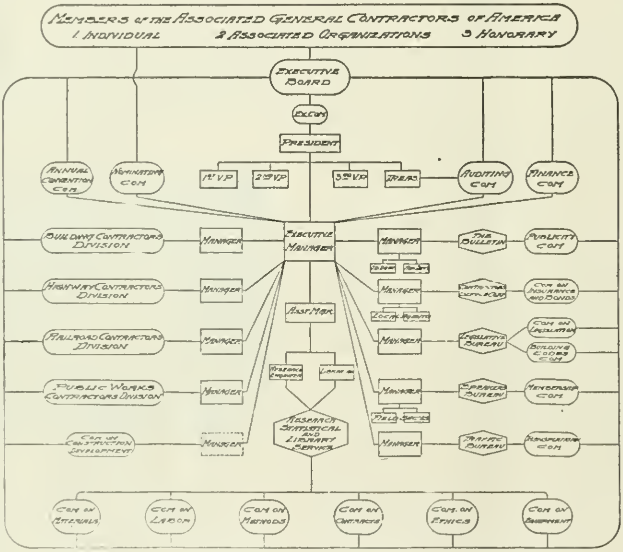


CHART OF PROPOSED ULTIMATE OFFICIAL DEVELOPMENT.

The duties of most of the committees are evident from their names. The Legislative Committee shall have charge of the legislative program of the Association, both state and national. It shall see that legislation of interest to general contractors is refered to the proper committee for investigation and report or investigate and report thereon itself. It shall have general charge of the Legislative Service hereinafter described.

The Committee on Construction Development shall have charge of promoting the best interests of building, highway, railroad, public works and other types of construction work. It shall have general supervision of the organization of the members of the Association in Divisions representing these types of construction to promote the special interests of these special fields as hereinafter described.

Provision is made for a corporation, owned by the association to act as agents for members of the association and other contractors in placing insurance and surety bonds. Another corporation, owned by the association, is authorized to publish a weekly or monthly magazine or news letter or both.

Other activities of the association are promoted by the special services authorized with headquarters at Washington to co-operate with the Legislative Committee in its work in keeping members informed regarding national and state legislation. The selection of a manager, counsel and other assistants shal be made by the Secretary with the approval of the Board.

A Library Service or Construction Index, which shall keep the Committees and all members informed regarding matters of interest to general contractors which are presented in current periodicals, bulletins, govenment reports, and other publications, shall be created to co-operate with the Executive Committee and the Secretary in their work with all the Committees.

A Personal Service which shall act as an exchange of information among members regarding men available for employment or positions open for men, and as a means of aiding members to find suitable men for their organizations, shall be created to co-operate with the Committee on Labor in its work.

A Surplus Equipment Service, which shall act as an exchange of information among members regarding equipment for sale or for rent and which shall aid members in securing proper equipment, shall be created to co-operate with the Committee on Methods in its work.

These changes and provisions have resulted from the tentative operations and the efforts and experiences of the officers and members of the society during the year that has elapsed since the business organizations were commenced. The co-ordination of the members, officials, and operations of the association are graphically indicated in the accompanying diagram which was presented as a working basis for the practical and rational organization of general contractors of all kinds. By a temporary combination of some of the different activities under single officials, it is believed that the plan can be adapted for the present requirements of the association and still provide for future expansion, great efficiency of operation, and advantage of members.

Water-front Foundation in Montreal

Driving and testing piles to carry a load of forty tons each along the river front of Montreal. About three thousand were driven by steam hammer in three and a half months.

The harbor commissioners of Montreal, Canada, having decided to build a large cold storage plant on the shore of the St. Lawrence river, found it necessary to support this plant on approximately 3,000 foundation piles, each to carry a working load of forty tons. The site of the plant was covered with a sand fill twelve to eighteen feet deep, and the commissioners considered it essential that the piles be driven entirely through this fill and penetrate the original ground beneath.

In order to insure that this supporting capacity would be obtained, the commissioners invited several pile companies to drive sample piles on the site at their own expense. Only one company consented to do this, and drove pile cores until the penetration under five blows of a Number 1 Vulcan steam hammer did not exceed one inch. Even under this heavy driving the piles failed to penetrate the stratum below the fill, and the commissioners declined to adopt this type of pile for the structure.

Finally arrangement was made with another company, the MacArthur Concrete Pile and Foundation Company, whereby it agreed to drive piles to a refusal of one inch for fifteen blows of a Number 1 Vulcan steam hammer, which the company believed would suffice to drive the majority of piles through the fill; to drive 750 linear feet of piles per day; and to guarantee that, if they did not pass entirely through the fill, it was because the fill was so compacted that this would be unnecessary. As a matter of fact, nearly all the piles were driven through the fill, some being subjected to thirty blows per inch of penetration, and some reached a maximum penetration of fourteen feet below the bottom of the fill, the average penetration below the fill being four feet. The guarantee of 750 linear feet of piles per day was exceeded by more than fifty per cent.

CONSTRUCTING THE PILES.

The piles used were those known as "pedestal piles," formed by driving a steel core and shell, then removing the core and filling the shell with concrete. For driving the piles the contractor used three wooden pile-driving towers with leads sixty feet high, equipped with a 6,000 pound Number 1 Vulcan steam hammer; hammer and tower combined weighing about twenty tons. One ½-yard Ransome and one 1/3-yard Smith steam driven concrete mixers were used for filling the pile shells, the concrete being placed by special one-half yard buckets. Cores and shells were used up to forty feet long.

TWO OF THREE LAND MACHINES BY WHICH 3,000 PILES WERE DRIVEN IN 107 DAYS.

The pile driver towers were assembled in position lying horizontal on the ground and were revolved into vertical position by tackles passing over tripping bents and operated by a hoisting engine. When erect, they were mounted on rollers of 16-inch pipe with solid cores which were placed between the bottom frame and the track sills: The steam-operated hoisting engine, which raised and lowered the hammer and provided the steam to operate it, also operated a tackle by which the tower was pulled forward on the rollers or skidded sideways on them, it requiring not more than one minute to set the machine in position for driving a new pile after the previous one had been finished.

The core was a steel pipe furnished with a shoulder near the top which rested on the top of the 16-inch steel shell, the top of the core projecting twelve inches above the shell and containing an oak driving block. The shell with the core in it was driven to one inch refusal under fifteen to thirty blows; the core was then removed and the shell filled with concrete by means of the special bucket referred to above, the bucket depositing about six cubic feet of 1:2 ½:5 concrete each time. After each charge of concrete, the core was replaced and operated upon by the hammer so as to compact the concrete. After each charge of concrete, the shell was raised about two feet, so that the concrete was driven into the surrounding ground, and it was calculated that the resulting pedestal had an average diameter of about 2½ feet, whereas the shell was only 16 inches in diameter. The tops of the piles were finished flush with the surface of the ground.

The driving of the 3,000 piles was completed in 107 days total elapsed time. The working force averaged about sixty men, who made a daily average of 54 piles with the three machines, the maximum record of any one machine being 32 piles. These piles averaged nineteen feet in length. The total amount of concrete used was about 3,600 yards.

TEST OF PILES.

In order to ascertain the condition and efficiency of the piles, an excavation was made which uncovered four of the piles to their extreme bottoms, and one of the piles was subjected to a test load of sixty-five tons. This load produced a vertical displacement of only ⅛ inch, and this was due to compression and not to settlement, since the pile head returned to its original position with the removal of the load.

In excavating down to the bottoms of the four piles, it was noticed that the driving had produced, for about twelve inches horizontally, a slight vertical displacement in the horizontal stratification of the filled-in soil, which fill had been deposited in definite layers about twelve inches thick, when it had been made by the hydraulic method. These strata all curved downward a few inches tangentially with the surface of the pile, showing that the very heavy frictional resistance developed in driving, together with some possible displacement of the soil below, had set up a definite movement in the earth and caused it to pack very firmly around the surface of the pile.

Cost-Plus Contracts Authorized

The Public Works Commission, Newark, N. J., has authorized the preparation of an amendment to the sewerage act empowering contracts to be made on the cost plus basis.

Improvement certificates from municipalities in the district are not acceptable to the commission as payment for the costs of sewerage construtcion. There is no authority either in the statute or the contracts which authorizes the acceptance of anything but cash. If the certificates could be negotiated without the commission assuming any liability the amount received might be credited.

The United Traction Company will be permitted to charge a trolley fare of 7 cents in Albany and Rensselaer, under a decision handed down by the New York State Public Service Commission, Second District. The order will become effective within five days after the company files its schedule of rates with the commission and will be operative for one year.

Municipal disposal of household garbage and waste is strongley urged by Dr. Paul R. Hoppe, who is leading a series of discussions at the Y. M. C. A. Fellowship Club meeting, on a theme "Practical Social Christianity" and thinks municipalities should get busy in matters of sanitation and housing.

$20,000,000 Inland Waterway Improvement

Frank C. Lowden, governor of Illinois, has received from the secretary of war a permit for the construction of the Illinois waterway, which will connect and make serviceable for water-borne commerce 15,000 miles of inland rivers in the middle west. The project embraces the improvement of the Desplaines and Illinois rivers.

Direct water route between Chicago and New Orleans and from the lakes to St. Paul and Minneapolis are established by the permit and when completed it will also open water connection with Pittsburgh and Ohio river points.

The cost of the work is estimated at $20,000,000. Locks will be 600 feet long and 110 feet wide, accommodating fleets of barge boats carrying from 6,000 to 8,000 tons of freight.

Street Snow Excavation by Power

A method of power excavation for snow is reported to be in use in some Canadian cities at a cost of $35.70 per thousand cubic yard, thus effecting an economy of $18.10 or nearly thirty-four per cent of the estimated cost of $53.80 per thousand cubic yards removed by hand shovelling.

The machine has a revolving cutter head driven by a 60-horse power gasoline engine mounted on a steel frame and sled and makes a cut 5½ feet wide, distributing the snow in a uniform horizontal layer at a distance of from 3 feet to 15 feet from the machine as desired. The initial cut is widened by trimming the sides with repeated operations of the machine. The machine can be drawn by a tractor or by from four to six horses, and will operate in snow up to 6 feet deep. It excavates the snow to within 6 inches of the surface of the ground thus leaving a sufficient bed for sleighing.

Such a machine would appear to be very useful for opening up traffic where there is sufficient room in the street to permit the snow to remain adjacent to the track, but where the snow must be removed the expense would of course be greatly increased by rehandling it to trucks or sleighs for removal.

Big Hydro Plant for China

China is planning to build the largest hydroelectric plant in the world, according to Jen Chow, a former Cornell man, who arrived here recently from the Orient to purchase machinery and supplies for the Chengtu Light and Power Company, as well as to study hydro-electrical development in the United States.

The plant will be built in the Province of Szechuan, making use of the enormous power, hitherto wasted, of the Yangtse rapids.

The report of George D. Craft, New York State Conservation Commissioner, urges the importance of conserving the state water power and that the state should construct dams and reservoirs on many streams in order to store spring freshets for the use during the summer drouth. Provision should be promptly made to stop the waste of the Niagara and St. Lawrence rivers and along the barge canal.

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False Work for Concrete Arch Bridges

Within a few years the construction of concrete arch bridge spans has so greatly increased that the practical methods and appliances have become of great importance and certain fundamental requisites have been substantially standardized so that general practice closely follows well defined lines that make for a general maximum of efficiency, rapidity, safety and economy.

The advantages of concrete arch spans have over ordinary steel construction in durability, in excess strength, in rigidity, in freedom from maintenance charges, in the elimination of transported materials and costly fabrication, and in the adaptation to artistic treatment have outweighed increased initial costs and have caused their adaptation in rapidly increasing proportion both for railroad and highway strnctures. The unprecedented amount of present and future highway construction add greatly to the large volume of arch span business.

In the construction of moderate-to-large spans, there is no feature likely to be more important and often troublesome than the proper support of the spans during construction, before the concrete becomes self-sustaining. At times it imposes excessive unbalanced loads on supports which must be very accurate and stable, must be capable of precise adjustment and should be easily installed and removed. These requirements are often difficult of attainment, especially for large and high spans. A large proportion of the cost of the work may often depend on the question of falsework and concrete supports the essential features of which are authoritatively treated on page 139 by the chief engineer of a notable organization that has for years been identified with the largest interests and most substantial development of these features.

Fixed Traffic Signals

During the past few years there have been constructed in all parts of the country, in both cities and suburban districts, permanent posts or standards carrying signs for the direction of traffic. These are especially frequent at the intersections of highways, for the purpose of requiring traffic to turn around the post and avoid short cuts across the corners. Many of these are of concrete or, in some cases, of cast iron, and would undoubtedly cause serious damage to a vehicle running into one of them at high speed. There have been a number of such accidents in cities, even where the post has carried a light, and the question arises, to what extent the city or other authority in control of the road is liable for such accidents.

This question is discussed in this issue by John Simpson. Mr. Simpson reports that he has not found any decisions applying particularly to traffic signs or posts, but that the general principles which apply to other obstructions would cover these also. No effort was made to discuss, in this article, decisions dealing with depressions, piles of building material, or anything other than *fixed* obstructions.

The general trend of the opinions appears to be that a city is not liable for accidents caused by running into obstructions in the highways where such obstructions serve a public purpose and have been located and maintained with reasonable care by the public authorities. Also, at least one decision appears to indicate that the authorities are not justified in creating such obstruction, if a reasonable amount of forethought and care would have enabled them to obtain the same result without endangering traffic.

As in most cases of similar nature, what the outcome of a suit for damages in any particular case would be, will depend largely upon the decision of the court and the jury as to the reasonableness and care which have been employed in connection with the particular obstruction involved in that case. Officials who are wise and who have consideration for the safety of the traveling public will not endeavor to steer as close as possible to the border between liability and non-liability, but will use not only reasonable, but an excess of care in deciding upon the kind and location of the traffic signals which they place in the highways, with a view to minimizing the danger of accidents therefrom.

Public Fuel and Power Station

The suffering in this country from a shortage of fuel and power has been considerable and the menace of increasing future scarcity and uncertainty is great, especially in large cities. The great concentration in congested areas, the rapidly increasing developments and distribution of power, and the universal reliance on public utilities for transportation, light, water, and for a large amount of heat in large cities, have almost eliminated individual resources in these matters, and have made the population 100 per cent dependent on public supplies. The reduction or serious interruption of these supplies is an enormous menace to safety, comfort and prosperity.

This danger has been demonstrated with increasing frequency of late. The natural causes, like storms, floods, severe cold and other physical conditions that operate adversely have been enormously increased by wilful and malicious political, industrial and social factors, chief among which have been labor profiteering and inefficiency. Unveiled threats against the life of the country have gone practically unrebuked and unresisted and it is time that efficient measures are vigorously taken, at no matter what cost, to protect the public.

Obviously the difficulty, waste and expense in securing, storing, and using fuel and in the development and distribution of light, heat and power increase proportionately with the sub-division and scattering of these units that involve a multiplicity of expensive branches, duplication of plants, increase of supplies, decrease of efficiency and enormous multiplication of labor, organization, and attendance. These all becoming more and more serious in geometrical ratio as the size and density of the districts and amount of fuel required increase.

A very sensible, rational suggestion has been made by Edwin Ludlow, consulting engineer and former vice-president of the Lehigh Coal & Navigation Co., who proposes that an enormous coal storage plant be installed on the unimproved and comparatively cheap Newark meadows, to provide a large reserve for the New York Metropolitan District, and that there also be established there a great central electrical power plant that could give independent service and supplement the existing plants. The site is admirably located, accessible to all railroads entering New York City and with available deep water front that makes it as nearly as possible immune from transportation blockades and congestion, and the territory is now unoccupied so that no unreasonable prices should be involved in its purchase. The feasibility of extraordinarily large storage and power plants may require further investigation and able expert study is of course necessary for even a preliminary formulation of the character and details of the proposed installation. The potential value of this scheme is so great and its importance as a public insurance is so evident that no time should be lost in a preliminary investigation by authorized experts. The results will be closely watched by all of our great cities, especially those on the seaboard.

Uplift of Engineering Construction

The political military, and financial necessities of the last few years that necessarily subordinated everything to winning the war, bore most heavily on the construction of all sorts of public works and other engineering schemes which to a large extent, were classified as non-essential and where not intrinsically impossible of execution, were generally discouraged and often prohibited. The succeeding period of unrest, uncertainty, diminished resources and production and extortionate prices have also been most demoralizing and injurious to great construction interests.

The prominent contractors who have been, are, and always will be, to a great extent, the builders of public works, realizing this condition, organized in the Fall of 1918 a great national society called the Associated General Contractors of America, with a strong membership highly representative of the ablest, most experienced and honorable men from every part of this country who were enthusiastically inspired with altruistic purpose to benefit the construction industry, the largest and most important in this country, that normally handles several billions of dollars of work each year.

It was the purpose of this organization to assist and inspire individuals, encourage local, municipal, state, and sectional construction organizations; to weld them all into one powerful central federation fitted to co-operate most efficiently with engineers, architects, public officials and other owners; to consolidate scattering efforts and direct them in the most efficient manner; to establish high standards; maintain friendly relations with business, political, social, industrial and financial interests; avoid repetition and conflict; and in general, to handle large issues and national questions from headquarters, leaving local and personal matters to the individual members or societies who would at the same time be able to avail themselves of the advantages of the main organization.

The association, starting with a splendid impetus, has been conservatively managed and its officers have carefully and persistently studied, investigated, and tentatively advanced until they have been able to formulate a sound plan providing for progress and development, as outlined on page 133 that promise to be of great importance in the execution of public works of all sorts, and which should receive the careful attention and hearty co-operation of owners, officials, and professional men affiliated with these interests.

The remarkable vigor with which the initial organization was accomplished has been conserved and increased astonishingly, developing a loyalty and enthusiasm that are so universal that the subscription of $200,000 for development and extension was accomplished in a few minutes. An organization having nation-wide membership of men able and eager to do this for high ideals can not fail to go far and high.

Adapting Quality to Requirements

In this period of extreme high prices and reduced production, the use of unnecessarily good materials or labor is an economic crime only less than that of using too poor materials or labor. Architects and engineers have very generally fallen into the habit of making a universal requirement for all materials to be of first quality only, entirely free from blemishes, imperfections, and any kind of fault. With an unfair or ignorant engineer, architect or owner or with an incompetent inspector, such specifications may produce great delay and damage without any resulting good when the letter of the specification is strictly adhered to without regard to conditions. Of course in many cases a broad gage, competent engineer or inspector will overlook many nominal imperfections or unimportant defects where they will not impair the strength or appearance of the structure. Specifications should only require strictly first-class materials or excessively painstaking work where they are really necessary, and should use discretion in accepting inferior grades where they will equally well serve all practical requirements and insure thoroughly satisfactory results. Such a course will expedite the work, reduce its cost and benefit both owner and contractor. Consideration and legitimate concessions to the contractor are appreciated by him and repaid in kind. Contractors can often advantageously suggest revision of specifications along these lines.

Constructing Roads for Motor Truck Traffic*

By T. R. AGG, Prof. of Highways Engineering, Ames, Iowa

Types of Roads Should be Developed With Improved Surfaces, Economic Considerations, Equitable Financing, Standard and Progressive Practice. Cost Should be Divided Between Local and Regional Assessments and Vehicle Taxation. Addition Data of Maximum Vehicle loads, the Supporting Power of Soils, and of Grade and Alignment are Essential to Good Design. Shorter, Wider, and Safer Roads are Being Developed. Maintenance is Greatly Benefited by Efficient Patrol Service.

Up to the present time the most important use of the motor truck outside of the cities has been as a supplement to rail transportation, the vehicles operating on routes paralleling the rail lines. The extent to which this will be profitable in times of normal rail facilities will depend upon many factors, one of which is the availability of paved highways of low tractive resistance and economical grades. The other factors are of an economic character and need not be discussed herein.

INDEPENDENT ROADS

Another important field for motor trucks is on transportation routes that open up territory or connect terminals not served by direct rail connections. Too little attention has generally been given to this possibility in laying out systems of state and county highways for improvement, in that too small a mileage of roads of this class have been provided.

Finally, motor transport will be employed for farm-to-market traffic on a vastly greater scale than at present. In this use the truck will to a great extent supplant the horse and the land now given over to supporting draft animals will produce human food which will all be needed. In very many states, especially those that are agriculturally productive, this development of traffic awaits only the building of suitable highways.

The continued successful utilization of motor transport for any purpose must depend upon ultimate economy and this factor will be influenced very largely by the type and location of the highways constructed and the condition of serviceability in which they are maintained.

In a broad sense, the construction of roads for motor truck traffic involves the adopting of types of improved surfaces, based on appropriate economic considerations, financing by methods that will distribute the costs in an equitable manner and accomplishing the actual construction in accordance with accepted practice in highway engineering, so far as practice has become standard, and blazing the trail wherever research and experience indicate the possibility of improved methods.

The financing of extensive surfacing projects involves very large sums of money, and conditions during the past few years have been favorable to highway financing so that comparatively little difficulty is experienced in obtaining money for road improvement. Looking to the future, however, it must be apparent that the completion of the projects now in contemplation in the United States will involve such enormous sums of money that a foundation of sane financing must be laid at the earliest possible moment. This is particularly true now that it is so generally recognized that an appreciable percentage of the highways of the nation must be constructed of such a character that they will be adequate for motor transport, of both high speed passenger vehicles and slower speed, heavy freight vehicles. Construction of this character is costly, although the cost is probably far below the actual benefit to the communities traversed.

It is believed that a system of financing that is in a general way based on distribution of cost according to benefits is justifiable and will be proof against claims of unjust discrimination in taxation for road improvement. The almost insurmountable difficulty lies in devising a means for determining where the benefits fall or the extent of the benefit.

LOCAL AND GENERAL ASSESSMENTS.

The construction in any community of adequate highways of year-around serviceability for motor transport, confers a real benefit on that community. A part of the cost of such an improvement might therefore properly and equitably be paid from general taxation in the district served. But the possibility of the district profitably utilizing the facility will vary greatly with the nature of the industries in the district and it is doubtful if any fixed percentage to be assessed as a general tax would be suitable for an area even as large as a state. Differences in assessed valuation of land would however tend to equalize taxation to a great extent even though the rate of taxation is uniform.

There is also a direct and tangible benefit conferred on agricultural land by the construction of improved roads contiguous thereto. Therefore a certain part of the cost of durable improvements can rationally and fairly be assessed against such lands. The percentage of the cost to be so assessed is not easily determined, but certainly should not in many cases exceed 25 per cent of the total cost.

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* Excerpt of paper presented at American Road Builders Annual Convention, Louisville, Ky., Feb. 9-13.

TAXING MOTOR CARS.

It probably will be admitted that the most apparent and tangible benefit from road improvement accrues to those who actually travel the highways for business or pleasure and since about 95 per cent of the tonnage on the nation's highways is made of various classes of motor vehicles, it follows that to them the benefit of improved roads is most apparent. The costs for fuel, for vehicle upkeep and the saving in time on improved roads are real and measurable benefits.

Some tests of a preliminary nature were made at Ames to determine the difference in gasoline consumption on various types of surface. While these were too few in number to be conclusive, they indicated 20 per cent as the possible saving between an average earth or gravel road and a high class paved surface. This would mean a saving on motor operation in Iowa of upwards of $3,000,000 a year. It is equitable to require the owners of motor vehicles to contribute somewhat to the cost of the improvement of the highways and very largely to the cost of maintenance. This has been recognized in recent legislation in several states.

The amount that is added to the cost of a road because it must accommodate motor truck traffic can hardly be taxed against others than owners of motor trucks, and it would seem probable that in the future both trucks and passenger vehicles will be required to bear an increasing portion of the cost of road construction and maintenance.

In the whole problem of highway finance, it is necessary to recognize that a roadway is being provided as a transportation facility that is not operated for direct income and the incentive to keep accurate account of the use of the facility in order to place the cost where the benefit is realized is lacking. Nevertheless, the great highway system desired by all progressive citizens can never be fully completed and maintained unless the financing is placed on a sound economic basis.

NECESSARY DESIGN DATA.

In the design of highways for motor transport the engineer is confronted with a problem for which he lacks some of the fundamental data for a complete solution. To begin with, he cannot predict with any assurance the size or weight of the vehicle for which he must provide, yet it is essential to an adequate design to know the maximum load for which provisions must be made. It is for that reason that steps are being taken, looking toward legal standards for the size and weight of motor vehicles.

Neither does the engineer know a great deal about the supporting power of soils under road slabs or the structural strength of road slabs of various designs. In these matters experience affords some guide to the establishment of the proper design, but refinements of design that would lower the first cost, are entirely within the range of possibility. In this field some investigations of great value have been completed, but much additional information is greatly needed.

In the field of railway engineering the relation between grade and curvature of the line and the cost of operation is fully established and when the tonnage of traffic is known, the justifiable expenditure for lowering grades or eliminating curvature can be computed. In the highway field no such data have as yet been obtained, and the design of grades and alignment of highways for motor transport is necessarily based on unsubstantiated assumptions.

WIDTH OF ROAD.

The standard double track width has been increased from 14 feet, the common width a few years ago, to 18 or 20 feet. The allowance per line of traffic has been increased from 8 feet to 9 feet. The width provisions have become more liberal in that almost no single track roads are being considered for the main routes of travel, and near populous centers many sections of three track road have been built.

ALIGNMENT.

Recognition is being given to the desirability of furnishing direct routes and shortening distances wherever possible. Pleasure traffic is not so much benefited by this as is business traffic. On busy routes a saving of a mile in traveled distance between towns, represents in a year a very appreciable saving in time and in operating cost for the vehicle.

Safety considerations have also entered into the design to a marked degree and dangerous sections of road are being eliminated by relocations or by extensive grading. The elimination of short radius curves and the superelevation of the paved surface on the curve are additional safety precautions that are being generally adopted. A great many railway grade crossings are being eliminated and where that is impossible, suitable warning signs are being posted. Guard rails for protection on fills are standard for main highways.

SURFACING.

The lessons of the past few years relative to the disastrous results that follow covering up poorly drained subgrade have been unmistakable. It seems now to be recognized that even a rigid pavement cannot give maximum serviceability when placed on a poorly prepared earth subgrade. The trend is therefore toward much more extensive and costly drainage work preliminary to the surfacing, but it is believed that money so expended adds very materially to the useful life of the wearing surface and is a justifiable expenditure.

In addition to the added care in the preparation of the earth foundation, heavier road slabs are being employed in many states and it is believed that this tendency is in the right direction. Wherever it is likely that truck traffic will develop, and apparently that is wherever roads are provided that will accommodate truck traffic, the accumulated experience of the past five years points clearly to the ultimate economy of heavy slabs.

Increasing attention is being paid to securing surfaces that are smooth, with a view to minimizing the effect of the impact of heavy loads. If the road surface is even slightly uneven disastrous pounding occurs when the truck travels at normal speed. This is a cause of rapid deterioration to both truck and road surface. As time passes it may be expected that the speed of freight vehicles will increase and while pneumatic tires will do a great deal to minimize impact, every reasonable precaution must be taken to secure smoothness of wearing surface.

MAINTENANCE.

A very general recognition is being given to the necessity for effective maintenance. No matter how admirable may have been the construction, a road surface subjected to motor truck traffic will not give a maximum of serviceability unless systematic and timely maintenance is provided. It will bear constant reiteration that nowhere is the old adage, "A stitch in time saves nine," more applicable than in highway maintenance. Patrol systems and the gang method have been developed to a high state of efficiency and the high degree of serviceability of a new road is maintained without marked depreciation for long periods of time. Timely maintenance if carried out persistently for a period of years probably costs less than spasmodic efforts to make repairs at irregular intervals and certainly continuous maintenance results in the greatest average serviceability.

Building Germantown Dam for 10 Cents Per Yard

The Germantown Dam in the Miami Conservancy District contains 865,000 yards of earth, and has slopes varying from 1 on 4 to 1 on 2 exclusive of the toe apron of 1 on 10. Most of the earth for the embankment is derived from a borrow pit occupying the full width of the adjacent valley where it is excavated by a dragline machine delivering to dump cars that haul to a storage bank at the foot of which is a sump provided with water supply and equipped with a 15-inch centrifugal dredge pump operated by a 400 h. p. electric motor that forces the mud and water into a basin formed in the heart of the dam by boulders and gravel depoited on the slopes.

The waste overflows and the residue packs to form a very solid fill. As the capacity of the dredge pump exceeded that of the dragline, additional material for this dam has been provided by excavating in the adpjacent side hill with a hydraulic monitor that is operated about 13 hours per day and washes 500 yards of clayey material into the sump whence it is pumped to the dam together with about 1,500 yards of bucket material provided by the dragline in two 10 hour shifts.

Gauge readings taken before and after the installation of the hillside excavator show no difference on the pressure head of the dredge pump which is thus able to carry 2,000 yards per day at the same cost that it previously carried 1,500 yards. Taking into account all expenses of installation and operating of the sluicing plant, the estimated cost of depositing hillside material in the dam is from 10 to 12 cents per yard. Materials are fed to the dredge pump through a revolving screen that has greatly increased the efficiency of the pump and enabled it to deliver 50,600 yards of earth to the embankment in the month of August.

The monitor installed for the hillside excavation is supplied with water by two centrifugal pumps and is operated to first undermine the face of the borrow pit until the bank falls down when it is washed into a trench by a stream of water provided by a third pump and is conveyed down the slope to the hog box or sump whence it is delivered to the dam by the dredge pump.

The dam is designed and constructed by the Miami Conservancy District, Arthur E. Morgan, chief engineer; Charles H. Paul, assistant chief engineer. The hydraulic fill operations here noted were illustrated and described in the Miami Conservancy Bulletin.

Newark Investigating Its Sewer Construction

In response to a communication from the City Commissioner of Newark, reciting that Director of Streets and Public Improvements Raymond had been authorized to conduct an investigation to determine the cause of delay in constructing the sewerage system, the Passaic Valley Sewerage Commissioners recently adopted a resolution declaring that "the books and records of this commission are always open to public inspection and that it and its engineers will cheerfully offer every facility" to the engineers appointed by the director to investigate the work of the commissioners.

Director Raymond also notified the commissioners that he had named Clyde Potts and C. C. Vermeule as engineers to make the investigation in connection with engineers of his department.

The engineers have been instructed to make a thorough technical and business-like investigation in order that the taxpayers may be satisfied that their money is being properly spent. Mr .Raymond says:

"From my personal point of view it seems to me thaf nine years was ample time in which to complete a public improvement such as this sewer, and that the people should be receiving the benefit of the $8,915,000 which has already been paid by them for this project."

Eight construction camps have been established. Two hundred and fifty men and more than 500 horses and mules are used. Construction contracts were signed last November.

Although engineers were retained only last August, construction has been forced so successfully that the system will be ready for use next April, the contract delivery date.

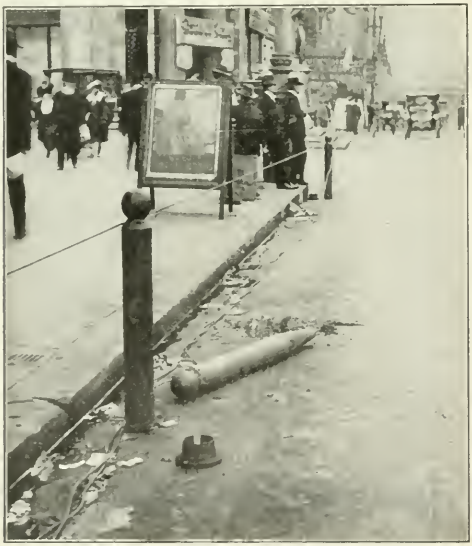
J. F. Mallon, project manager, is father of the project. Eugene C. Mills is chief engineer for the district.

In connection with the $20,000,000 worth of new improvements now being made at Atlantic City, announcement is made by the State Highway Department of New Jersey that the last gaps in a continuous modern highway between New York and Atlantic City will be closed in the early part of the present summer.

ROPING BACK CROWDS.

Most of the parades in San Francisco take as their route Market street, from the Ferry building to the city hall. To confine the crowds to the sidewalks during parades, the police department has adopted the plan of stretching a strong rope along the street near the curb, this being supported by heavy wooden posts at regular intervals. The posts are set into holes in the roadway pavement, about a foot out from the curb. To protect the edge of the hole and to hold the post firmly, a flanged iron collar is set into the top of the hloe. An iron cover similar to the cover of a small waterworks valve box) is kept on each hole when the posts are not in place. (One of these covers is shown in the foreground of the illustration.) At street intersections, the rope is laid in the adjacent gutter until a few minutes before the approach of the parade, when it is drawn across the intersecting roadway by the policeman in charge of each intersection. Police department wagons follow up the parade and the posts are loaded into these and the rope is wound up on drums, the entire equipment being stored in the basement of the "hall of justice."

SPECTATORS KEPT OFF ROADWAY BY ROPE.



GUARD ROPE FOR CONTROLING PARADE SPECTATORS.

Lancaster's Centrifugal-Electric Pumps

The following describes the 1919 operation of the Lancaster, Pa., electric pumping plant, which replaced the old steam plant as described in our issue of March 1st, 1919.

The total amount of water pumped for the year 1919 into the standpipe and reservoir was 2,623,150,000 gallons. The number of gallons of raw water pumped to the filter plant for filtering was 2,789,450,000 gallons. The average head against which the high-duty pump operated was 232 feet, while the low-duty pumps operated against a head of 40 feet. The high-duty pumps used 2,786,750 kw. h., for the year, and the low-duty pumps used 535,269 kw. h. The average highest peak load of 10 minutes duration for any one day was 563 k. w. The average h. p. input for the high-duty pumps was 426.0, while the output was 283.3. For the low-duty pumps, the average h. p. input was 84.2 and the output was 58.2.

The high-duty pumps showed a per cent of efficiency for the year of 66.4; the low-duty pumps showed 71.4. The overall efficiency of the pumps was 67.3 and the station efficiency was 64.9.

The number of kw. h. used per 1,000 gallons pumped through the high-duty pumps was .471 and the low-duty pumps was .443.

The cost of operation for the year was $42,821.72. Basing the operation by steam, using the former steam plant, on the present cost for labor and cost of coal and pumping the same number of gallons, the cost of operation would have been $54,403.76.

DISTRIBUTION OF THE WATER PUMPED.

Of the total number of gallons pumped during the year 1919, 541,906,000 gallons passed through meters for domestic use; for saloons, hotels, breweries and bottling establishments, 104,292,000 gallons; manufacturing purposes, 487,315,000 gallons; schools, churches and colleges, 33,610,000 gallons; water supplied outside of the city limits, 58,002,000 gallons; filter plant, 19,162,000 gallons, or a grand total of 1,213,287,000 gallons. The difference, which is 1,409,873,000 gallons, may be distributed through 6,654 properties that obtain water on a schedule rate, for the flushing of streets, fire purposes and places where water is furnished free.

The filter plant showed a total efficiency in the removal of bacteria of 99.38 per cent.

The plant is being operated with the highest per cent of efficency and every effort made to keep the cost of operation down to a minimum. The plant as it stands today is 95 per cent new. It is in charge of John L. Coyle, chief engineer. We are indebted to C. K. Will, superintendent of the Water Department, for the above facts.

Pavement Tests

Concrete pavements in California are tested by cutting out samples 4½ inches in diameter with a core drilling machine that cuts through the thickness of the pavement in from 5 to 14 minutes according to the age and aggregate of the concrete. Tests of pavements made with broken rock, sandstone gravel, and volcanic rock gravel, all showed a compressive strength of 3,000 pounds per square inch or more.

Liability of Municipalities for Fixed Obstructions in Streets

By John Simpson

Decisions of courts in the various states (except in New England) have established that a municipal corporation is liable for dangerous conditions in its streets caused by its negligence; but not for obstructions which serve a public purpose and are set and maintained with the exercise of reasonable care and not in such a position as will render the street unsafe.

In establishing, maintaining and caring for streets, highways, and public parks, a municipality acts in its governmental and not in its proprietary capacity, and from the earliest times it has been the recognized rule that a municipality is not liable in damages for negligence in performing its governmental functions, unless such liability has been imposed by statute. But by what is termed (in the case of Lane v. Minnesota State Agricultural Society) as an "illogical exception to this rule," it has become firmly established in most of the States, including the Middle and Western States, that a municipal corporation is liable for injuries resulting from defects or dangerous conditions in its streets, caused by its negligence where it is given exclusive authority and control over them and possesses means for their construction, improvement and repair.

The Minnesota Supreme Court considers that the various reasons assigned for making a distinction between such cases and those governed by the general rule are not very satisfactory. The reason most generally assigned is that such municipalities, having been given the exclusive control over their streets, with ample power to provide funds to care for and maintain them, are chargeable with the duty of keeping them safe for travel; and that it follows by implication therefrom that they are liable for failure to perform such duty.

While it is difficult to see why the same reasoning would not also impose liability upon cities for negligence in performing many of their other governmental functions, the exception, logical or otherwise, is now too firmly established to be questioned.

The New England States, however, as well as some others, do not recognize the exception to the general rule, and hold that a city is not liable for defects in its streets unless such liability is expressly imposed by statute.

The liability of a municipality for obstructions in the streets, however, is for negligence only. It is not an insurer against all defects or obstructions, and is not required to do everything that human ingenuity can do to prevent injury to citizens. Its duty is to exercise reasonable care only to construct and maintain its streets and walks reasonably safe for the purposes to which they are devoted, and for the use of persons traveling thereon by the usual methods" by day or by night, and who are themselves using reasonable care. (West Virginia Court decisions.)

Municipalities are not required to furnish the best possible method of passing around natural obstacles. Especially will those be stopped from complaining who, well knowing the means which have been provided for avoiding danger, have sustained injuries in consequence of their own neglect to avail themselves of them. (Mississisppi.)

The Kansas Supreme Court holds that the existence of a post or other object large enough to upset a buggy or wagon running over it within a carriage-width of a traveled track is not necessarily, and as a matter of law, such an obstruction as renders the city liable for injuries occasioned thereby. It may or may not be such an obstruction, depending on a variety of circumstances; and ordinarily, whether it is or not is a question of fact to be determined by the jury. In other words, the city is not bound, as matter of law, to keep not only the traveled track in good and safe condition, but also to keep a space of a carriage-width on each side of such traveled track free from posts, stones or other objects large enough to upset a buggy or wagon running over them. It is, of course, the duty of the city to keep its streets in a reasonably safe condition for travel in the ordinary modes. In the discharge of this duty, in some places it must keep the whole width of the street in a safe condition for travel. In other places it is sufficient to keep a traveled track in good repair.

A person who knows of a dangerous obstruction in a street or sidewalk, and yet attempts to pass it when, on account of darkness or other hindering causes, he cannot see so as to avoid it, takes the risk upon himself. For a much greater reason does he take the risk upon himself if, seeing an obstruction and knowing its dangerous character, he deliberately goes into or upon it, when he was under no compulsion to go, or might have avoided it by going around. (Pennsylvania, New York, Massachusetts, and Indiana decisions.)

In an action against a city for personal injury caused by a runaway team alleged to be due to the breaking of one of a number of hitching posts which the city had caused to be set in a street, it was held in Illinois that the city was not liable. The court said: "There is no duty imposed by law upon the city to provide or maintain hitching posts. If there may be supposed to be any duty resting upon the city in regard to the sufficiency of the posts, as arising from having undertaken to set them, there could be no such duty as to see that absolutely safe posts were set; but no more would be required, as we conceive, than the exercise of ordinary care in the setting of such posts as would be reasonably sufficient, under all ordinary circumstances, for the purpose of hitching posts."

Many cases support the rule that not every defect or obstruction will render the municipality liable for injury; it is only danger which can or ought to be anticipated in the exercise of reasonable care and prudence, that the municipality is required to guard against.

Where a person, in Mt. Vernon, N. Y., was injured by tripping over a water pipe which projected four inches above the earth surface between the flagstone and the curb, an instruction to the jury was held proper that, if the obstruction was so slight that no careful man would apprehend danger from its existence, the city was not liable, and that it was not chargeable with negligence for an accident which, according to common opinion, was not likely to happen.

The street is to be pronounced sufficient or insufficient as it is or is not reasonably safe for the ordinary purposes of travel, considering the nature of the place and such reasonable limitations as may be put upon the use of the way for travel by virtue of other public necessities, convenience and safety.

Hitching posts, electric light poles, telephone or telegraph poles, hydrants and fire plugs are not considered unlawful obstructions if placed at the curb or margin of the street so as not to render the roadway unsafe. (New York, Pennsylvania, Massachusetts, Indiana, Illinois and Georgia decisions.)

But the fact that contrivances are necessary and usual to effect the purpose desired will not justify the municipality in maintaining them in such a position as will render the street unsafe. In a Mt. Vernon, N. Y., case it was held that an obstruction caused by a waterpipe projecting four inches above the surface differs materially from such objects as carriage stones, lamp posts, and hitching posts, which are easily discernible by a traveler, and the purposes of which require them to be above the grade of the highway. As also in Huntington, W. Va., where two valve boxes projected several inches above the sidewalk.

An instructive case is that of Gottsberger v. the City of New York, where it was held that no recovery could be had against a city for injuries caused by falling over a stringpiece, 12 inches high, placed on the side of a street to protect a water pipe, and to prevent teams going up and down a pier at that point from colliding with each other, unless the stringpiece was shown to be a dangerous obstruction to public travel, since every obstruction in a street is not actionable. The stringpiece was not a nuisance in itself, and city's liability must rest upon negligence. There was nothing out of repair, and consequently, if the city was liable at all, it was liable for permitting something to exist which constituted a dangerous obstruction of the public highway. If every such obstruction were actionable, no water hydrants, trees, hitching posts, telegraph poles, awning posts, stepping-stones—not even the stoops of the houses projecting beyond the house lines—could be permitted to remain. The mere fact that the plaintiff was injured while proceeding in a hurry could not be held sufficient, in the face of the fact that the stringpiece had fulfilled a highly useful purpose for many years and that such purpose was a public one.

The court in the foregoing case referred to a former New York decision, where it was held that it is not negligence to construct a fence separating a bridle path from a foot path in a park; and a horseman who goes on the foot path at night and is injured by his horse falling over the fence, cannot recover. The construction of the fence, so far from having been a negligent act, was held to be a precautionary measure to prevent equestrians from getting upon the walk reserved for pedestrians, and injuring the latter. Referring to the cases, which it considered analogous, where people have been injured by driving against water hydrants, trees, hitching posts, telegraph poles, etc., the court said that in this class of cases it has been invariably held that there was no liability on the part of the municipality; and that the question as to how much of a street shall be set aside for the driveway and how much for the sidewalk, trees, gutter, etc., is, in the absence of a controlling statute, matter of municipal discretion.

While it is the duty of a municipal corporation to use reasonable care to keep its streets in a safe condition to drive upon, it has the right to devote the sides of the streets to other useful public purposes, provided it leaves an unobstructed driveway of ample width for the passage of teams. It may construct sidewalks of a higher grade and gutters of a lower grade than the driveway, place curbing on the line of the gutters, erect hydrants and authorize the erection of hitching posts and stepping stones, as well as poles to support the wires of telegraph and telephone lines. It may lay out grass plots on the sides of the streets, set out trees therein and protect both grass and trees from injury by fences or other reasonable means. It may thus to a reasonable extent, and for a useful public purpose, narrow the driveway and exclude teams altogether from the sides of the street. If a person drives against the curb either on the one side of the street or on the other side of the driveway, it is his own fault or misfortune, for one object of the curbing is to prevent driving beyond its lines. (Horseheads, N. Y.)

The New York Supreme Court has held that a city is not liable for allowing to remain in a street stepping stones placed by third persons to avoid the muddy places, where there was nothing that led to an anticipation of their being or becoming unsafe. The same was held of a stepping stone just inside a curb at Kingston, N. Y.

A city cannot, of course, be held liable for an obstruction which it was not instrumental in establishing and is powerless to remove. The Virginia Court has held that a city was not liable for injury to a traveler from a rope put across a city street, to prevent travel and the resulting noise, by order of the judge of a state court.

Ralph Avenue Sewer, Brooklyn

Deep Sheeted Trench Excavated by Steam Shovel and Clam Shell Buckets and Large Invert Concreted Far in Advance of Arch. Aggregate Unloaded and Stored by Power Equipment. Concrete Forms Moved on Cars. Plant Largely Operated by Electric Power.

A section of the Ralph Avenue Sewer, Brooklyn, has been completed at a cost of more than $900,000 and work is in progress on the construction of the lower end of the sewer and on the design for the outfall crossing about 1,000 feet of salt marsh, where the construction has not yet been commenced.

The incompleted section of the sewer consists of a concrete semi-circular invert from 10½ feet to 13 feet, 10 inches in width, that connects at the lower end with twin rectangular sewers 13 feet, 2 inches wide.

It was at first proposed to construct brick arches over the semi-circular invert, but owing to the scarcity of brick during the war the design was changed to a reinforced concrete arch which can be built with greater rapidity than the brick, and with a class of labor more easily secured and managed and more satisfactory in their operation thus, expediting the work and completing it at a slightly lower cost than for the brick construction. The work is executed according to the design and under the supervision of the Department of Sewers, Borough of Brooklyn, by J. F. Cogan, contractor.

EXCAVATOR FOR SEWER TRENCH.

TRAVELING PUMPING PLANT IN ADVANCE OF INVERT.

EXCAVATION, SHEETING, AND PUMPING.

The excavation in sandy soil to a maximum depth of 18 feet has been made with a ¾-yard Bucyrus steam shovel working in the trench, supplemented by two ¾-yard clam-shell buckets operated by stiffleg derricks mounted on 20x30 feet, 8-wheel platforms running on a track of 20-feet gage, one rail of which was laid on each side of the trench. The derricks were operated with hoists, manufactured by the Maine Electrical Company, Portland.

Ground water level being at a height of about 10 feet below the surface, it was found necessary to sheet the lower part of the trench with 6x1-inch planks 8 feet long with the lower end sharpened to a chisel edge. They were driven by a McKiernan-Terry Air Hammer supplemented by an air jet from a ⅛-inch nozzle and a ½-inch pipe. In this manner some of the pile units were driven 4 feet in less than one-half minute. Air pressure was provided by a portable Chicago Pneumatic Tool Company's machine and the supply to the jet was controlled by a valve regulated by the operator.

The trench was drained by electrically driven centrifugal pumps mounted on a car and kept a little in advance of the concreting of the invert where they were operated continuously.

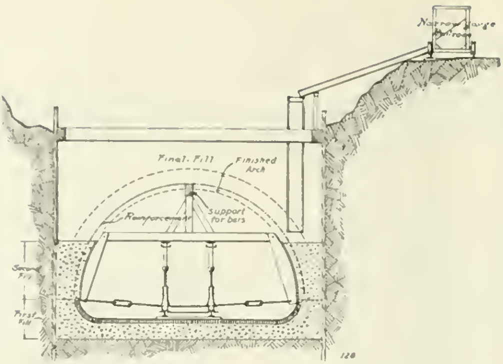
CONCRETE PLANT.

Cement was received in bags loaded on box cars and aggregate on standard gage flat cars hauled over the Long Island Railroad to a point where they were delivered to the contractor's siding. Here they were spotted in the required position near the unloading derrick by a small hoisting engine operating a wire cable that was run through anchored sheaves at both ends of the siding and enabled the cars to be pulled in either direction.

The aggregate was unloaded by a clam-shell bucket operated by the 55-foot boom of a stiffleg derrick equipped with a Nagel Steam Hoisting engine. It was dumped in storage piles from which it was delivered by bucket elevators to a 15-yard hopper bottom storage bin in the upper part of the mixer house.

The cement bags were handled by a bag elevator to cement storage house that was located, adjacent to the mixer house, under the concrete floor of a Long Island Railroad bridge that afforded additional protection from the weather.

Aggregate was delivered by gravity to the measuring hopper of the 1-yard cubical mixer manufactured by E. H. Wachs, Chicago. This mixer was installed at an elevation of about 8 feet above



a narrow gage track on which there were operated side dump cars receiving the concrete.

Water supply was obtained by a well point driven 15 feet to the water bearing stratum of sand and connected to a steam pump that maintained an abundant supply in an elevated tank over the mixer house.

Coal was received, like the aggregate, in standard gage cars, unloaded by the clamshell bucket and delivered by it directly to the boiler house where there was installed a 65 H. P. locomotive type boiler providing steam for the entire plant.

DISTRIBUTION OF CONCRETE.

The average output of the mixer was 110 yards of concrete in one 8-hour shift with a mixer force of 4 men. The machine delivered the concrete directly into small hopper cars with a sliding gate on one side through which the contents were discharged.

The cars were hauled by locomotives on a narrow gage service track extending the full length of the sewer trench. The oil burning steam locomotives first used were afterwards superseded by Plymouth gasoline locomotives, manufactured by J. D. Fate Co., Plymouth, Ohio. The delivery of the concrete to the forms was accurately controlled by the operation of the gates in the cars and the service was considered very rapid and satisfactory.

At the lower end of the trench the surface of the ground was not high enough to permit concrete to be spouted to all parts of the work by track laid on it. Therefore the elevation of the track was increased without extra expense by making an embankment with part of the spoil from the excavation and laying the rails on it.

CONCRETE FORMS.

The arch was concreted in two successive portions for each section. The form for the first or lower section was carried on a small car running on a narrow gage track laid in the invert for that purpose. The sides were adjustable by turnbuckles and the form was raised and lowered by jackscrews to permit accurate adjustment and partial collapse to strip it from the finished concrete.

The semi-circular reinforcement bars were set in position and accurately spaced over the first form and were supported at the crown on a movable longitudinal wooden beam that remained in position until after the haunches had been concreted. When this concrete had set it held the bars firmly in position, permitting the removal of the crown support simultaneously with the collapse and removal of the first form. The second form was similarly constructed and operated in a manner similar to that described for the first form.

Except for the steam plant operating the concrete installation and the locomotive hauling the concrete cars, as much use as possible was made of electricity, furnished by the Edison Company, who laid a special line for the purpose. The use of electricity was considered economical and satisfactory, and was preferred to steam because it could be handled with less experienced operators.

Highway Situation in the Middle Atlantic States

Review of Construction Conditions in Four States in 1919 and Forecast for 1920. $75,000,000 of Work Last Year Hampered by Inefficient Labor, Excessive Labor Turnover Up to 1,00 Per Cent., Shortage of Materials and Cars and by Bad Weather. In 1920 There Are Planned 2,100 Miles of Road at a Cost of $100,000,000 and the Transportation of 11,500,000 Tons of Aggregate and Labor Questions are Serious Problems.

In a paper presented at the fifth annual meeting of the American Association of State Highway Officials, Samuel Knopf, assistant engineer of the Delaware Highway Department, gave a comprehensive survey of "The National Highway Situation in the Middle Atlantic States." The states included in his review were New York, New Jersey, Pennsylvania and Maryland.

The highway construction in 1919 approximated 1,900 miles, and the cost was nearly $75,000,000.

Money for construction was available and, with few excetpions, work began in full swing, with indications pointing to record construction. When the working season had ended, however, only about 40 per cent of the program had been completed. This was due primarily to labor conditions, shortage of materials brought about by lack of equipment available for transportation, and weather conditions.

At first it was thought that labor would be plentiful, especially in view of the demobilizing of the army. But the returned soldiers did not take kindly to road work, and laborers for this had generally to be recruited largely from former munition workers. These had been accustoced to high wages, and were not readily satisfied with wages averaging 45 cents an hour, while the savings from war wages made it unnecessary for them to work. In addition, there was a large exodus to Europe, from certain districts of these states, of labor usually engaged in this kind of work. As the season progressed, labor became more unreliable. Some contractors imported labor from cities 75 miles distant. As an illustration, one job 2½ miles long requiring an outfit of 50 men had, at the end of the work, a pay-roll containing 500 different names. This labor turn-over, besides delaying the progress of the work, influenced bidding prices and quality of workmanship.

There was an actual shortage of materials also. Manufacturers found labor uncertain, their equipment in bad shape, due to forced war work and, with no chance to replace it, they could not keep up with the production demanded. Equipment for transportation was in bad shape. Even now, there is a distinct shortage of cars for the movement of coal, grain and other commodities, and this condition became so acute during the last few months of the 1919 working season that it almost put a stop to the construction program.

On account of bad weather, the Middle Atlantic states were able to conduct actual roadway operations during only about 60 per cent of what is usually a fair average working season. In view of the shortage of material, however, it is doubtful whether much more work could have been done, even had the weather been more favorable.

The lateness and hesitancy of awarding some of the contracts naturally delayed the program. Contractors who were looking for prospective work marked time and did not arrange for needed plant as a result of which, equipment orders piled up as the season progressed and deliveries of plant came too late for the working season. One of the results of this was that bids received late in the season ranged from 10 per cent to 15 per cent higher than those submitted earlier, when every indication had pointed to straight sailing in road construction.

HIGHWAY LEGISLATION.

State legislation affecting highways was notable, especially along two lines: laws affecting the weights and tonnage which could be carried by motor trucks and the use of traction engines on important highways; and legislation empowering the Pennsylvania highway commissioner to acquire land containing stone for road building purposes, which stone may either be used by the state or sold to contractors engaged on highway contracts under the state's jurisdiction.

HIGHWAY REVENUES.

Besides the annual revenue derived by taxation for road purposes, bond issues and other sources of money in the several states were as follows:

Pennsylvania—$50,000,000 in state issues; $17,000,000 in county bond issues authorized, and $8,500,000 in county bond issues proposed.

New Jersey—$5,000,000 in state bond issues; $1,000,000 in county bond issues authorized, and $4,500,000 in county bond issues pending.

New York—$12,000,000 of the bond issue of 1912, and $7,500,000 approximately of county bond issues authorized, with a proposed state bond issue to be introduced to the Legislature for $100,000,000.

Delaware—$2,000,000 in state bond issues; $1,750,000 in county bond issues authorized, and $1,500,000 private fund.

Maryland—No state bonds had been passed or were pending; this road program was carried on by legislative appropriation.

To these amounts of money must be added the considerable increase of funds available under the Federal Aid Act and the Post Office Appropriations Act, this amounting to $32,400,000 for the years 1919-'20 and '21, of which $5,500,000 was applied to road building during 1919.

THE 1920 PROGRAM.

Appropriation for road building in 1920 in these states is even larger than last year's. It calls for the constuction of about 2,100 miles of hard-surface highways at an expenditure of about $100,000,000. What amount of this will be completed is problematical. The limiting factors will be the same as those of last year—the amount of labor and materials available, including the ability to get the materials on the ground, and the lack of experienced and fully equipped contractors' organizations.

The program to be carried out requires the moving of 11,500,000 tons of aggregates, which amount includes the tonnage required to complete the projects carried over from last year's work. The aggregate problem is rendered more difficult by the fact that building operations, railroad improvements and street and road maintenance, which also were seriously curtailed during 1919, and in fact, throughout the war, will require these materials with the anticipated resumption of operations in 1920.

One element of this problem is the transportation of the materials. From the middle of February to the middle of April, 1919, more than 200,000 open-top cars, such as are used for hauling road materials, were standing idle. No new equipment for transportation will be forthcoming under the federal administration, and, owing to the financial difficulties involved in the return of the roads to private ownership, no plans have been formulated for securing new equipment. It therefore becomes more than ever urgent that as much material as possible be moved during the eight or ten weeks following the middle of February, in order to minimize as far as possible the congestion of railroad traffic in the spring and early summer.

As to materials, there is unfortunately an indication that there will again be a shortage of some of these. In the Lehigh Valley, which supplies this district with cement, there is normally on hand at the end of the year about 15,000,000 barrels of cement in stock. Last December there were only about 2,000,000 barrels on hand. Many plants for the manufacture of both cement and other materials and equipment have shut down or gone on to part time for several weeks or months, on account of the shortage of fuel.

As to labor, the labor condition in this section of the country is at a critical stage. There is nothing to indicate that labor will be more efficient or more abundant or more willing to work at reasonable wages this year than it was last. "Not until labor realizes that it is no longer engaged in war work, that no war profits and war wages exist in honest road building will there be any change in the shiftless, unreliable work performed this year (1919). Any tendency to increase their wages, as was done in some instances this year, seemed to decrease their efficiency. Contractors, to meet this kind of work, have turned to labor-saving machines, and it is safe to predict that these devices will be used where possible."

TO FACILITATE COMPLETING THE PROGRAM.

All hands appear to be realizing that, to cope with this crisis, more efficient co-operation between all parties is necessary. The greatest degree of cooperation between contractors, highway departments, material producers and railroads will be required for even approximately completing the 1920 program. To this end the highway departments issued prospectuses of 1920 work before the end of 1919, announcing that contracts were to be advertised during the months of December to April. It is hoped that this early anouncement of the construction program, giving contractors full opportunity to look over the roads, locate sources of materials, investigate terminals, etc., will stimulate them to assemble plant and materials ready for work, make financial and preliminary arrangements in advance of actual operations, and do everything possible toward completing a large proportion of the season's program.

Several highway departments have carried on extensive material service and propaganda campaigns for the establishment of small local material plants, as well as securing available local supplies for contractors with crushing equipment. Pennsylvania, as noted previousy, has empowered her highway commissioner to purchase and acquire land containing stone suitable for highway purposes, to purchase machinery and equipment to operate such quarries, and to use such stone for their own highways, and to sell it to contractors engaged on constructing roads under the department's jurisdiction.

If possible, material estimates should be allowed, in order to encourage early and regular deliveries of materials in advance of actual operation without imposing a considerable financial burden upon the contractor. In 1917 the Delaware Highway Department found it difficult to secure bids on her road work, until she announced that substantial materials estimates would be allowed, when her entire program was readily put under construction. Materials estimates were allowed during 1919, and, even though shipments were spotty and irregular, enough materials were on hand to tide them over and prevent delay in the work.

Contractors can assist by perfecting adequate organizations and employing labor-saving machines to replace some of their labor. Wonderful strides have been made during the past few years in labor-saving devices used in road building, such as central proportioning plants, direct charging systems, sub-grading machines, finishing machines, etc. Orders for machinery of this kind should be placed early enough to insure their delivery for the present working season.

It is obvious, however, that the controlling factor will be transportation. Railroads should place in service all existing equipment, keep it repaired to the fullest extent, and purchase new equipment if possible. Manufacturing plants should be rated in accordance with their capacity, and the distribution of cars made on such a basis without discrimination.

As to labor, the United States Immigration Bureau reports that the exodus of labor to Europe is about normal, and that there will be a return influx of labor during the early spring. This should have a tendency to stabilize labor conditions and prevent further increase of wages for common labor this year.

In view of these various adverse conditions, it is difficult to foresee or predict what percentage of the 1920 road program will be completed, but the state highway departments will unquestionably make every effort to complete the program outlined, and will be generally backed up by the public, and all concerned will make every effort to put through the greatest possible amount of work this season.

Maintaining a Concrete Street

The city of Fort Collins, Colo., in 1916 constructed 24,000 square yards of six-inch reinforced concrete, and in 1917-18 built 30,000 additional square yards. No repairing was done to this pavement until the spring of 1918, when the joints of the original 24,000 square yards were poured with tar at a cost of 0.2c per square yard.

During 1919, one barrel of pitch (obtained from the Denver gas plants at a cost of $6.30 sufficed to maintain the joints) in 10,000 square yards.

The method of making repairs employed in Fort Collins is as follows: Tar is used having a melting point of 110 degrees F. for work in the spring, or about 105 degrees if in the fall, the lower melting point giving greater elasticity under cold-weather conditions. If the pitch has a higher melting point, it is cut back to 105 degrees by adding a quart of creosote per barrel for each degree reduction in melting point desired. The pitch is heated to between 225 and 250 degrees in portable tar kettle of 110 gallons capacity; a glass thermometer registering to 500 degrees being used during the heating. If the temperature threatens to rise higher, the fire is pulled from under the kettle.

Meantime, the pavement is prepared by sweeping the dust away from the joints by use of a street broom, then thoroughly brushing out the joint with a long handled wire brush and following this with an ordinary house broom; these operations being repeated until all dirt and foreign matter have been removed.

The tar is then poured and the surface covered with dry, coarse sand, preferably preheated to about the same temperature as the tar.

The Fort Collins pavement is practically free from cracks, but where cracks occur they are handled as described above for joints.

Public Works in Paterson, N. J.

Work done by Board of Public Works during 1919, with unit costs, in cleaning, oiling and repairing streets, cleaning and repairing sewers, and collecting refuse with electric and gasoline trucks and horse-drawn wagons.

Paterson, N. J., has an area of eight and one-quarter square miles and a population of about 135,000. The various public works of the city are in charge of a Board of Public Works, with city engineer, H. J. Harder as the engineer.

This board directs the collection of ashes and garbage, the operation of a destructor plant; the cleaning, flushing and oiling of streets; repairing and resurfacing pavements; repairing and cleaning sewers; and some other minor work.

During the year 1919 the board expended for these purposes:

For collecting ashes and garbage	$86,086.05
For operating destructor plant	15,839.09
For cleaning macadam streets	11,795.04
For miscellaneous street work	7,000.21
For cleaning pavements and flushing streets	28,908.06
For repairing pavements	4,777.95
For resurfacing streets	23,707.84
For oiling streets	10,550.83
For repairing and cleaning sewers	14,220.61

STREET WORK.

The amount of cleaning done on macadam streets was 4,101,000 square yards, 5,817 cubic yards of dirt being removed. The cost averaged $2.8761 per thousand square yards of street cleaned, or $2.028 per cubic yard removed. Of the total cost, $1,960 was was for team hire, $7,592 for wages and $2,242 for maintenance.

Resetting curb cost on the average 32.1 cents per lineal foot; flagging gutters, 26.8 cents per lineal foot, and cobble gutter, 38.5 per square yard.

Inspectors on the above work cost $4,897. A new flusher was bought for $9,600, and autos for the city engineers for $1,049.

In cleaning pavements, 11,396 cubic yards of dirt was removed from 54,770,000 square yards cleaned, at a cost of $2.3106 per cubic yard, or $0.4804 per thousand square yards. Of the total cost, $25,700 was for wages, $113 for team hire, and $518 for maintenance.

In addition, 5,016 miles of flushing was done, using 9,683,100 gallons of water, at a cost of 2.92 cents per thousand yards flushed. The flushers used 3,283 gallons of gasoline and 500 of oil. The expenditure for wages was $1,506, and for maintenance $1,070.

Repairing asphalt block cost an average of $1.760 a square yard; brick, $1.51; concrete, $2.00; Belgian block, $1.63; wood block, $.7276. The average for all was $1.90, of which $1.22 was for wages and $.6796 for maintenance. A contract was let for repairing 5,573 square yards of asphalt pavement at $1.68.

In repairing 63,763 square yards of macadam, 6,356 cubic yards of stone was used, and the cost averaged 37.18 cents per square yard. Oiling streets cost 4.37 cents per square yard; 241,533 square yards having been oiled, using 73,259 gallons of oil and 356 cubic yards of stone.

SEWER WORK.

The following were the amounts and unit costs of sewer work: 23,625 linear feet cleaned at 11.65 cents per foot, 272 cubic yards of dirt being removed at $8.12 per cubic yard. Ten repairs cost $86.20. In cleaning 7,048 catch-basins, 1,045 cubic yards of dirt were removed at a cost of $4.08 per cubic yard or 60.55 cents per cleaning, 454 receiving basins were cleaned, 983 cubic yards being removed at an average cost of $3.09 per yard or $6.70 per basin. About 80 per cent of these costs was for wages.

REFUSE COLLECTION AND DISPOSAL.

In collecting ashes and garbage the city used four electric trucks, three gasoline trucks and fourteen horse-drawn wagons. The first removed 55,401 cubic yards at a cost per yard of 45.42 cents plus 10.84 cents for overhead, or 56.26 cents total. The gasoline trucks removed 5,522 cubic yards at a cost of 53.53 cents, plus 28.97 cents for overhead, or 82.5 cents total. Collection by horse-drawn wagons cost 53.73 cents (no overhead given). In all, 142,283 cubic yards was removed at an average cost, including overhead, of 60.5 cents.

The destructor plant incinerated 34,000 cubic yards of this material at a cost of 40.94 cents per cubic yard. In addition, $1,920 was spent in carting 2,983 cubic yards of clinker from the plant.

City engineer Harder has compiled some very interesting data concerning the collection of ashes and garbage by the three types of vehicles, which we will give in another article.

Much Road Construction in Louisiana

At the end of the year 1919, the State Highway Department of Louisiana, according to report of the Bureau of Public Roads, stood first in the Sixth Federal Road District in the number of federal aid road projects submitted to the bureau, agreements for road construction approved, and money paid out as reimbursements to the state account of roads constructed under the federal aid road act.

"According to a tabulation of the status of federal aid projects to January 1, 1920 there are 36 in Louisiana, 19 of which are under construction and 2 of which are completed.. The percentage under construction is 52.7 per cent with 5.5 per cent complete. Federal aid has been alloted to the extent of $3,741,751.52. The total aid on active projects is $1,233,991.38 or a percentage of 32.9.

"The tabulation for other states shows: Number of projects in Texas, 122; Oklahoma 22; Arkansas, 51. Projects under construction: Texas, 34; Oklahoma, 5; Arkansas, 20; Completed: Texas 3; Arkansas, 3. Percentage under construction: Texas 27.9; Oklahoma, 22.7; Arkansas, 39. Percentage complete, Texas, 2.5; Arkansas, 5.9; total federal aid alloted $16,091,245.04; Oklahoma, $6,341,878.29; Arkansas, $4,615,210.57.

Annual Paving Statistics

Facts and figures from several hundred cities concerning the amount and nature of work done by each during 1918. (Fourth instalment.)

TABLE NO. 7—RESURFACING PAVEMENTS.

City and State	Kind of pavement resurfaced	Years in service before resurfacing	Kind of traffic carried	Material used for new surface	Treatment of old pavement before resurfacing	Cost of resurfacing per sq. yd.	Use made of old material
California:							
Oxnard	Oil macadam	7	Business	Warrenite	Spiked and broken up; oil cake and part of rock removed.	$1.08	On dirt streets
Redlands	Oil macadam	7	Both	Asphalt	Leveled up with rock asphalt applied at 350° F. covered with screenings.	.225	....
San Francisco ..	Oil macadam	10	Residence	Topeka mix, 2"	Cleaned, asphalt paint applied by power sprayer.	....	....
Santa Barbara .	Macadam	10	Business	Oil and rock	Scarified, rock and oil added, rolled.	.18	....
Connecticut:							
Hartford	Sheet asphalt	21	Business	Sheet asphalt	Old asphalt removed, concrete foundation repaired in places.	....	None
	Macadam	..	Business	Macadam	....	....	None
New Causan ...	Macadam	Very old	Residence	Gravel & crushed stone	Scarified in some cases.	....	....
Stamford	Macadam	5 to 10	Both	Tar macadam, 3½"	Scarified and reshaped.	1.00	None removed
Illinois:							
Winnetka	Macadam	10 to 15	Both	Tarvia A & cr. stone, 3"	Scarified and regraded.	.25-.50	None removed
Iowa:							
Indianola	Wood block	7	Business	Tarvia B	Swept clean, hot tar app'l'd, heavily sanded.	....	....
Sioux City	Wood block	Relaid 1913	Business	Asphalt	Removed blocks and base complete.	4.23	None
Kansas:							
Parsons	Macadam	22	Residence	Broken limestone	Scarified, trued up with grader; stone added and ¾ gal. per sq. yd. of oil.	.305	None removed
Kentucky:							
Madisonville ...	Macadam	10 to 15	Both	Limestone, 6"	Scarified, harrowed, reshaped.	.90	....
Massachusetts:							
Cambridge	Macadam	..	....	Tar macadam	Scarified, worthless material removed, new stone added, rolled; Tarvia B penetration and small stone added.	....	....
	Tar macadam	..	Business	Tar macadam, 6"	Scarified, old material removed; finished as above.	....	For paving side streete
	....	..	Residence	Tar macadam	Scarified, broken up fine, new stone added as above.	....	....
	Brick	16	....	Bitulithic	Holes and depressions filled with bit. binder course.	....	....
Haverhill	Macadam	8 to 12	Both	Stone & asphalt	Scarified and part removed.	....	Resurfacing dirt roads
Lawrence	Sheet asphalt	20	Both	Warrenite	Old asphalt removed, concrete base cleaned (cost, $0.30).	1.93*	....
Lexington	Bit. macadam	15	Both	Stone & Tarvia B, 4"-5"	Scarified, old tar removed, harrowed, rolled.	....	Subgrading roadways & sidewalks
Winchester	Macadam	..	....	Brok. stone & Tarvia X	Brought to uniform cross-section.	....	None removed
Nem Hampshire:							
Nashua	Macadam	..	Both	Asphalt	Scarified and rolled.	....	....
New Jersey:							
Irvington	Telford macadam	7	Business	Asphalt surface treat.	Scarified.	.40	None removed
Ridgefield Park.	Asphalt macadam	7	Both	Stone & Tarvia X	Scarified, raked over; 1½" of ¾" stone added, Tarvia and screenings.	.65	None removed

New York:							
New York-Bronx	Asphalt block	..	....	Granite block	Pavement removed, new base laid.	....	....
	....	..	....	Sheet asphalt; "Durax"	Surface removed and old base used where good.	....	....
New York-Manhattan	Asphalt block	10	Business	Sheet asphalt	½″ removed after heating. (Will be described in detail in a week or two.)	.98	....
N. Tonawanda..	Macadam	3	Both	Slag, tar & screenings	Scarified; 4″ of crusher-run slag, 2½″ of graded slag, screenings for binder. Tarvia, ¾ gal. per sq. yd. by penetration method, then screenings; then ⅛ gal. Tarvia and screenings.	....	Dressing shoulders
Port Jervis.....	Gravel	..	....	Shale	....		....
Syracuse	Asphalt and brick	18 to 25	Both	Asph., brick & bit. conc.	Replaced with same class of materials.	Asph., 1.90 Brick, 3.25	Repairing brick pavements
Troy	Granite blocks	30	Business	Same blocks	Blocks removed, split, renapped and relaid.	....	....
Pennsylvania:							
Butler	Brick, slag base	15	Business	Brick	Old base resurfaced with 3″ of slag screenings and well rolled. Some old brick turned and used.	2.08†	....
Mechanicsburg .	Brick	9	Both	Brick	Badly worn brick removed, cushion examined.	1.92	Brick used for gutters and crossings
Tennessee:							
Harriman	Macadam	20	Both	Bit. macadam	Scarified.	.10	....
Texas:							
Brownwood	Macadam	3 to 5	Business	Trap, asphalt binder	Scarify and roll.	....	....
Temple	Brick	6	Business	Asphalt	Flushed, hand-cleaned with wire brooms, swept and flushed.	.28	....
Vermont:							
Burlington	Macadam	..	Both	Standard binder B	Scarified, reshaped, new stone added where necessary.	1.00	Patching dirt roads
Washington:							
Raymond	Plank	10	Both	3″ plank	High spots trimmed down, low ones shimmed up.	.99	....
Spokane	Asphalt	18	Business	Asphalt	Surface heater used and 1½″ added.	.90	....
Walla Walla ...	Asphalt	10 to 15	Both	Bitulithic	Old surface removed, base swept.	1.80§	Spread on another road, broken up and rolled
Wisconsin:							
Wausau	Macadam	6	Residence	Asphalt oil	Scarified, new aggregate added, rolled and oiled.	1.00	....

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*In addition to $0.30 for preparing base. †Includes resetting curb. §For 2″ top and binder; $1.40 for 2″ top only.

Table No. 9.—Gravel Pavements Laid in City Streets During 1919.

City and State.	Yards or miles laid.	Av. cost per sq. yd.	Thickness, Inches.
Colorado:			
Leadville	½[a]	[b]...	6
Massachusetts:			
Greenfield	4,000	...	4
New Hampshire:			
Nashua	20,000[c]	$1.00[D]	..
Washington:			
Dayton	800[c] [D]	...	6
Waterville	113	0.58[D]	7

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[a] Gravel not rolled.
[b] Work was volunteered and gravel was donated.
[c] Gravel was rolled.
[D] Does not include other work.

Table No. 10.—Bitulithic Pavement Laid in City Streets During 1919.

City and State.	Yards or miles laid.	Average cost per yd.	Base Kind.	Base Trickness, Inches.
California:				
Oxnard	70,103	$1.80	....	4
Santa Barbara	[a]79,235	1.78	concrete	4
Colorado:				
Pueblo	76,900	2.26	concrete rock	4-5 4
Idaho:				
Boise	7,902[d]	2.22[D]	....	..
Iowa:				
Centerville ...	35,000	3.77	1:3:5 concrete	5¼
Massachusetts:				
Cambridge ...	55,375	2.00[b]	old brick	..
Lawrence	17,346[c]	2.23	macadam	..
Lawrenceville .	6,110[c]	2.23	concrete	..
Minnesota:				
Duluth	44,622	3.50[D]	concrete	6
Montana:				
Bozeman	23,486	2.63[D]	crushed rock	4
Nebraska:				
Columbus	65,663	2.84	concrete	5
New Jersey:				
Irvington	3,061	3.80	concrete	6
New York:				
Gloversville ...	3,800	2.32	old	..
No. Tonawanda	13,700	3.09	....	5
Troy	18,600	3.25	1:3:6 concrete	5
Wyoming:				
Sheridan	18,000	2.64[D]	concrete	5

[a] Bitulithic and Warrenite.
[b] Cost including base.
[c] Warrenite.
[d] Gravel.
[D] Does not include other work.

Table No. 11.—Macadam Laid in City Streets During 1919.

City and State.	Yards or miles laid.	Av. cost per sq. yd.	Thickness, inches.
California:			
Kentucky:			
San Francisco.....	4,063	$0.967	..
Madisonville	11,000	0.90 .	6
Minnesota:			
Duluth	25,000	...	6
New York:			
Troy	2,200	2.50	6
Oregon:			
Eugene	1,600	1.00[D]	6
Pennsylvania:			
Mechanicsburg	3,605	1.86[D]	..
Rhode Island:			
Providence	46,377	...	6

[D] Does not include other work.

Since the organization of its highway department in 1917 Delaware has built 70 miles of fine roads, put 30 miles more under contract, and completed surveys for more than 50 miles to be built by the state which has about $3,000,000 available for expenditure this year.

New York State Highway Commissioner, Frederick Stuart Greene, has recommended to the legislature the purchase by the state of road machinery and road materials which he estimates would effect an annual saving of $750,000.

Cost of Operating Contractors' Plant

Editor Public Works, New York City.

Dear Sir:

The writer was especially interested in an article on page 304 of the issue of "Municipal Journal" of November 15. The article in question was a notice of action taken by the Association of General Contractors of America regarding machinery manufacturers giving costs on the operation of equipment to public officials and having these costs so low that a contractor could not bid anywhere near the figures stated and make money.

It is the writer's opinion that their attitude is absolutely a just one and that the contractors have a real grievance when this is done. The writer, however, has been selling machinery for the last ten years and has made repeated efforts, over a period of seven of the ten years, to obtain actual operating costs on the kinds of equipment which we sell. Within the last few months he sent out a series of twenty letters to representative contractors, asking for typical costs under ordinary operating conditions. From the whole series of letters there was only one reply, and the costs given in this case were only approximate.

As long as the contractors take this attitude and refuse to give any information the writer does not exactly see how they can expect to have any salesman give a prospective customer anything more than theoretical cost units, giving items covering original purchase price, interest, depreciation and operating expenses as they would appear on paper, realizing that these are probably too low, but with no other figures to aid them.

Should not, in your opinion, the contractors, if they want this matter corrected, take some definite sort of action toward supplying reliable figures?

You must, of course, realize that many cities, counties and states and highway departments operating equipment themselves give out figures (some of which are sent to you and similar journals for publication) which are also totally unreliable, since items of overhead, and often interest and depreciation, are left out entirely; and the writer has even suspected that some of the published articles have gone beyond this point and purposely neglected to state known items of cost in order to make the operating conditions in their city seem very low, hoping for the appreciation of their own taxpayers and to be able to use these figures to beat down the contractors' bids on such parts of their work as they might be letting by contract.

Would be glad to have a discussion along this line in the editorial columns of "Public Works."

Yours very truly,
KINNEY MANUFACTURING CO.,

WILLIAM E. WORCESTER.
Manager, Philadelphia Office.

Making a Road on Wet Ground

About 700 feet of road was laid through a very wet spot on a hill in Lee, Mass., in the following manner, as described by Harry W. Heaphy in a communication to "Public Works":

A four-inch vitirfied pipe was laid three feet deep in the middle of the road, the joints being left open. The ditch was then filled with broken stone. Previous to this the road had been straightened and some necessary cutting and filling done. The drainage ditch having been constructed, cinders were placed so as to give a thickness of eight inches after compacting.

Following the construction of this piece of road there was a very rainy season, and on either side of this stretch the road was quite muddy, but this drained piece was as dry as a floor. This work was done by town labor.

Reinforcing Old Concrete Bridge Floor

The 3-inch concrete floor slabs in steel truss bridges at Blossburgh, New York were so much damaged by heavy freight traffic that it was recently necessary to resurface them.

After being swept and washed clean the surface was treated with a 5 per cent solution of hydrochloric acid which was washed off and followed by a thin wash of cement grout on which there was immediately laid a 2-inch course made in the proportion of 2½ bags of cement to 1 cubic foot of sand and 5 cubic feet of ¼ to ¾-inches trap rock mixed with the minimum amount of water necessary to make it plastic.

As no construction joints were provided, air cracks developed in the lines of the old expansion joints 18-feet apart but have not opened or caused any injury to the pavements which has been in service for two years without showing any signs of broken bond or cleavage where old and new concrete are joined. The work is considered entirely satisfactory and is expected that the floor will last as long as the bridge structure itself.

Value of Short Hauls

The importance of reducing distances for highway transportation is illustrated by the following table prepared by A. R. Hirst, State Highway engineer, Wis. On the conservative allowance of 10 cents per mile per vehicle cost of transportation, the capitalized value of each mile saved varies from $73,000 to $7,300,000 according to amount of traffic amounts which certainly justify considerable expenditure for the rectification of roads:

Average Number of Vehicles per day	Saving to Owners per Year	Saving Capitalized at 5%
100	$3,650	$73,000
250	9,125	182,500
500	18,250	365,000
750	27,375	547,500
1,000	36,500	730,000
2,000	73,000	1,460,000
5,000	182,500	3,650,000
10,000	365,000	7,300,000

The Ingahm County, Mich., board of supervisors has reduced the salaries of the county road commissioners from $1,500 to the nominal sum of $150 a year, plus necessary expenses, in the hope of eliminating any financial attraction and securing more competent and public spirited administration of the work.

The Pennsylvania State Highway Department states that the average cost of road construction thus far has been $41,500 a mile. This covers all types of roads for which $27,020,120 is the cost and 648 the mileage. Reinforced concrete has been constructed for $44,000 a mile, while the average for bituminous concrete is $41,000; for sheet asphalt, $15,000; while brick roadway, (usually hill construction) of which only 6.75 miles have been let runs to nearly $64,000 a mile.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Rights of Court to Interfere with City Officers—Release of Valuable Rights.

(N. Y. Sup.) The courts must not interfere with the discretion of local officers and municipal bodies, and must not attempt to manage the affairs of a municipal corporation, but may restrain an abuse of discretion in releasing valuable rights for a consideration that will substantially fail.—People's Gas & Electric Co. of Oswego v. City of Oswego, 177 N. Y. S. 625.

Annexation by City—"De Facto Corporation."

Cal. App.) Where there has been an attempt, under Municipal Annexation Act of 1913 and amendments thereto, to annex one city to another, and where authorities of former city have declared annexation to have been carried at an election held to decide the question, and where such city as an incorporated city has ceased to function, and the latter city has assumed jurisdiction over its territory and inhabitants, the latter city, as to such annexed territory, is a de facto corporation.—Coe v. City of Los Angeles, 183 P. 822.

The requisites of a de facto corporation are a charter or general law under which such a corporation, as it purports to be might lawfully be organized, an attempt to organize thereunder, and actual user of the corporate franchise.—Id.

Ordinance Requiring Privies Void.

(Fla.) A city ordinance, requiring the establishment of privies in every house and building, however used or occupied, and requiring compliance with the provision of the ordinance within 15 days after notice from health commissioner, or within such further time as he may allow, permits an arbitrary discrimination by him, and is void.—Ellis v. Thiesen, 82 So. 607.

Power of City to Grant Lighting Franchise.

(S. D.) A special charter giving a city power to provide for lighting the streets and erecting posts for conveying electric lights and lines and to regulate the distribution of gas and other illuminative fluids empowers the city to grant a franchise to an electric light corporation to furnish electricity to the ctiizens.—City of Watertown v. Watertown Light & Power Co., 173 N. W. 739.

Liability of City to Pay Contract Price.

(U.S.C.C.A.Okl.) Where a municipal corporation, which has power to make a contract for internal improvements, contracts for them and stipulates that the agreed price shall be paid out of funds t obe realized from special assessments, which it has power to make, but fails and refuses to make sufficient valid assessments, it becomes primarily liable to pay the contract price itself.—Oklahoma City v. Orthwein, 258 F. 190.

Zoning Ordinance Applied to Laundries Constitutional.

(Cal. App.) Los Angeles Ordinance No. 22798 (New Series), a residence district ordinance, and No. 26555 (New Series), providing that in order to establish an industrial district within a residence district it is necessary to get a petition signed by property owners, etc., are constitutional and apply to laundries.—Sam Kee v. Wilde, 183 P. 164.

Right to Impound Animals at Large.

(Colo.) The city of Pueblo has the right to impound animals running at large and to charge the delinquent owner a reasonable amount for so doing.—City of Pueblo v. Kurtz, 182 P. 884.

Letting Office of City Treasurer Unconstitutional.

(Tex. Civ. App.) A city charter, if it purports to authorize the letting by contract to the highest and best bidder of the office of city treasurer, etc., to that extent is unconstitutional.—City of Corpus Christi v. Mireur, 214 S. W. 528.

Power of City to Regulate Business.

(Ohio) When a city has the right ,under its police power, to impose a regulation upon a business, the validity of an ordinance relating thereto cannot be attacked merely because its scope was not extended to cover the entire field of possible abuses which such ordinance seeks to prevent.—Yee Bow v. City of Cleveland. 124 N. E. 132.

Councilman as Tax Equalizer—Salary of Officers.

(Cal. App.) Under the charter of Richmond, providing that no member of the council shall hold any other municipal office, that the council shall act as a board of tax equalization, and that the councilmen shall receive $5 per day while performing that duty, but no other compensation, unless provided by ordinance, they perform the duty of equalization as members of the council, so that an ordinance providing a salary for them increases their compensation, within Const. art. 11, § 8, providing that this shall not be done during their term of office.—Cameron v. City of Richmond, 183 P. 604.

Under statutes relating to street improvement contracts, contractor cannot impede or embarrass the municipality, or vex its officers, by putting the contract on the market to be sold or bartered as a commodity.—Id.

Provision of sidewalk construction contract, requiring city's consent to assignment of contract is valid and enforceable.—Id.

Assignment of contractor's interest in sidewalk construction contract without city's consent, in violation of provision of contract requiring such consent, conferred no rights upon assignee.—Id.

Where sidewalk construction contractor assigned interest in contract without city's consent in violation of contract, a purchaser from assignee of assignee's right, title, and interest in special assessments acquired no rights in assessments, since assignment, being invalid, conferred no rights upon assignee.—Id.

Civil Service Examinations—Powers of Health Board—Information to Applicants.

(Cal.) Under the San Francisco City Charter, the board of health and the Civil Service Commission are independent of each other, and the board has no authority to prescribe qualifications for civil service eligibles.—Pratt v. Rosenthal, 183 P. 542.

The fact that the Civil Service Commission of a city placed veterinarians on the same basis as persons experienced in handling meat, fish, and fowl in examinations for market inspectors does not show an abuse of discretion.—Id.

A civil service examination notice which stated that copies of certain regulations would be distributed as long as the supply held out does not indicate a violation of San Francisco City Charter, prohibiting special information being furnished any applicant, since it will be presumed that any applicant failing to secure a copy would be allowed to inspect the original records.—Id.

Davenport, Iowa, is open to a proposition for the removal of its garbage by contract. The contract that has been in operation for several months has been abandoned with disastrous results for the city which has no garbage wagons and will have to expend approximately 6,000 dollars to supply them if it makes its own collection.

NEWS OF THE SOCIETIES

March 1-5. NEBRASKA ROAD INSTITUTE. Third meeting. Temple Theatre, Lincoln, Neb. Chairman, Clark E. Mickey, University of Nebraska, Lincoln, Neb.

March 8-9—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. Annual Convention at French Lick, Ind. Secretary-Treasurer, L. R. Taylor, French Lick, Ind.

March 8-10. INDIANA SOCIETY OF SANITARY ENGINEERS. Richmond, Ind. Secretary, Indianapolis, Ind.

March 10.—VERMONT SOCIETY OF ENGINEERS. Meeting and convention at Burlington, Vt., Secretary, George A. Reed, Montpelier, Vt.

March 16-18. — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Manhattan Building, Chicago.

March 24-25. NATIONAL WHOLESALE LUMBER DEALERS ASSOCIATION, Washington, D. C. Secretary, 66 Broadway, New York.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

March 24-26. SOCIETY OF INDUSTRIAL ENGINEERS. Bellevue-Stratford Hotel, Philadelphia. Secretary, 327 South La Salle St., Chicago.

March 25. NORTH CAROLINA PINE ASSOCIATION, Norfolk, Va. Secretary, Norfolk, Va.

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

Associated General Contractors of America.

W. A. ROGERS
President—1920.

At the annual meeting, Chicago, February 18-19, the opening address was made by President D. A. Garber, responded to by an address of welcome by William Hale Thompson, Mayor of Chicago. Important reports were presented by G. W. Buchholz, secretary; C. F. Mullen, Treasurer, and by the Chairman of the Auditing Committee, A. P. Greensfelder; Membership Committee, L. C. Wason; Publicity Committee, Edward Haupt; Committee on Codes, Thomas Bentley; Committee on Transportation, G. W. Buchholz; Committee on Ethics, Noble Foster Hoggson; Committee on Legislation, W. A. Rogers; Committee on Methods, A. P. Greensfelder; Committee on Labor, M. D. Smith; Committee on Contracts, J. W. Cowper; Committee on Construction Development, E. J. Thomas; Committee on Constitution and By-Laws, L. C. Wason; Finance Committee, F. J. MacIsaac, and the various Convention Committees.

The following papers were presented: Organizing the Construction Industry, Ernest T. Trigg, president National Federation of Construction Industries; Prices, Production and Construction, Harold G. Moulton, Professor of Economics, University of Chicago; Industrial Relations, Dudley Taylor, District Counsel, League of Industrial Rights, and J. H. Ellison, Winston Brothers Co., St. Paul, Minn.; Forms of Contracts, Sutton Van Pelt, Division of Waterways, Department of Public Works, State of Illinois; James O. Heyworth and A. E. Wells; Standards in Construction, A. B. Segur, A. B. Segur & Co., industrial engineers, Chicago; A National Department of Public Works, Gardner S. Williams, National Public Works Department Association, Washington, and Frank I. Bennett, Director Ill. State Department of Public Works and Buildings; The Disposition of the Realroads, Samuel O. Dunn, editor Railway Age, and Richard Waterman, secretary Railroad Commission, Chamber of Commerce, U. S. A.; Washington Affairs, George R. Shields; The 1920 Highway Program, I. T. Voshell, chief, Bureau of Public Roads, U. S. Department Agriculture; Improving State Highway Contracts, A. R. Hirst, State Highway Engineer of Wisconsin, and Clifford Older, Chief Highway Engineer of Illinois, and H. W. Church; The Expense of Estimating, Henry K. Holsman, president, Illinois Chapter, A. I. A.; the National Board of Jurisdiction Awards, E. J. Russell, chairman, National Board of Jurisdiction Awards; The Joint Conference Plan With Labor, A. P. Greensfelder, Fuim-Colnon Construction Co., St. Louis.

There was a large attendance at the smoker and entertainment on the evening of February 18, on the inspection trip to the plant of Universal Portland Cement Co., where luncheon was served February 19, and at the annual dinner, February 19, where D. A. Garber was toastmaster and the sentiment "To the Associated General Contractors in 1920" was responded to by W. A. Rogers, W. O. Winston, R. G. Collins, Jr., Walter Cahill, Frederick L. Cranford, T. T. Flagler, J. W. Cowper, C. F. Mullen, E. J. Thomas, M. D. Smith, George Watson, A. P Greensfelder, Thomas Bentley and L. C. Wason.

The officers elected for 1920 were: President, W. A. Rogers, president Bates & Rogers Construction Company, Chicago; first vice-president, T. T. Flagler, president The Flagler Company, Atlanta; second vice-president, J. W. Cowper, president The John W. Cowper Company, Buffalo; third vice-president, W. O. Winston, president Winston Brothers Company, Minneapolis; treasurer, C. F. Mullen, secretary and Treasurer The Masters & Mullen Construction Company, Cleveland. Members of the Executive Board (four whose terms expire January, 1923)—R. G. Collins, Jr., Cumberland, Md.; Walter Cahill, Great Lakes Dredge & Dock Company, Chicago, Ill.; Arthur Bent, Bent Brothers, Los Angeles, Cal.; George Watson, Watson Company, Dallas, Texas..

The creation of the Advisory Board was accomplished by the election, to hold office for one year, of D. A. Garber (chairman), president North-Eastern Construction Company, New York City (retiring president); W. A. Rogers, president Bates & Rogers Construction Company, Chicago (retiring first vice-president); F. J. MacIsaac, secretary and Treasurer Smith Hauser & MacIsaac, New York City (retiring director); George J. Glover, director New Orleans General Contractors Association, New Orleans; Frederick L. Cranford, president Frederick L. Canford, Inc., New York City.

Very strong support was given to the carefully formulated plans presented for the development of the association's interests and the most enthusiastic endorsement was shown by the subscription of $200,000 for this purpose.

Important revisions and amendments were made to the constitution and by-laws that more clearly defined the special aims of the association, grade its membership, enlarge the Executive Board and provide for an Advisory Board. They also specified a sliding scale of dues for the different classes of members.

North Carolina Drainage Association.

At the convention to be held Feb. 25, 26 and 27 at the Elks Hall, Hotel Louise, Washington, D. C., the principal papers presented and topics discussed will include:

Drainage Work in the Southeastern States, by Judge N. A. Morris, president, Southern Drainage Journal, Marietta, Ga.

Settlement of Our Reclaimed and Unused Areas, by Clement S. Ucker of the Southern Settlement and Development Organization.

Flood Control as Related to Drainage, by Thorndike Saville, Professor of Hydraulic and Sanitary Engineering, University of North Carolina.

Some Drainage Problems in the Great Swamp Area of North Carolina, by H. M. Lynde, Sr., Drainage Engineer, Office of Public Roads and Rural Engineering.

Problems of the Drainage Contractor, by C. W. Hodges, Newbern, and J. A. Wilkinson, Belhaven.

Malaria Control, an illustrated lecture, by Dr. Chas. E. Low, Supt. of Health of New Hanover County; given under auspices of the N. C. Landowners' Association.

Tile Drainage of Flat Lands, by F. O. Bartel, Drainage Engineer, N. C. Department of Agriculture.

Tile Drainage Contests Conducted by N. C. Drainage Association, by Prof. M. E. Sherwin.

Making Drain Tile, by W. C. Boren, president Pomona Terra-Cotta Company.

Distribution of Clays in North Carolina Suitable for Making Drain Tile, by Col. Joseph Hyde Pratt.

Five-Minute Reports on Drainage Districts.

Piedmont Drainage, by W. D. Alexander, M. P. Moore, L. O. White, Q. E. Smith and C. A. Black.

Drainage Projects of the Coastal Plain, by W. K. Allen, C. W. Mengel, R. R. Eagle, B. M. Potter, M. W. Thompson, J. I. Heritage, F. F. Wetmore, J. L. Becton, C. G. Elliott, Z. V. Norman, O. L. Williams, J. D. Grimes, J. I. Duncan, Frank M. Wooten, Pat Matthews and C. C. Howard.

Results of Drainage on the Norfolk Southern Farms, by R. K. Smith, vice-president Norfolk Southern Land Co.

Potter Farms, by J. E. Shepherdson, general manager.

Soils of Some of the Swamp Areas and Their Agricultural Values, by Wm. Battle Cobb, of the U. S. Bureau of Soils.

Maintenance of Drainage Ditches, by W. K. Allen and W. D. Alexander, drainage engineers.

Five minute discussions of the North Carolina Drainage Law, by Congressman Small, W. Lee Crowell W. D. Alexander, P. H. Johnson and J. D. Paul.

Nebraska Road Institute.

At the meeting at Lincoln, Neb., March 1-5, there will be a number of trips of inspection to local works; an evening smoker; the annual meeting of the Nebraska Engineering Society; an address by Governor S. R. McKelvie; the annual banquet; and there will be presented the following papers.

Federal Aid in Nebraska, by Jas. C. Wonders, Federal District Engineer; Administration and Organization of Department of Public Works, by E. H. Morey, Chief of Bureau of Roads; Construction of State Highways, by A. S. Mirick, Chief Construction Engineer, Department of Public Works; Maintenance of State Highways, by Geo. E. Johnson, Secretary Department of Public Works; County Highway Patrol for Maintenance, by A. H. Edgren, Lancaster County Engineer; Evolution of Nebraska's Highways, by Prof. Geo. R Chatburn; Evolution of a County Bridge, by D. L. Erickson, Deputy County Engineer, Lancaster County; Highway-Railway Crossings, by F. T. Darrow, Ass't Chief Engr., C. B. & Q. R. R.; Nebraska Cement Company, by Louis J. Hoenig, Sales Manager; Nebraska's Road Material Resources, by Dr. Geo. E. Condra; Nebraska Good Roads Association, by Geo. F. Wolz, President; The Use of Trucks in Building and Maintaining Roads, by Geo. E. Johnson, Secretary Department of Public Works; Motor Operation and Transport Service, by Marcus Potete; Motor Transportation in Nebraska, by Loyd Winship, Secretary and Treasurer, Hebb Motor Company; Motor Transport Rates, by Thorn Brown, State Railway Commissioner; Model Methods in Highway Educational Work, by James W. Brooks, Director, Educational Bureau, Federal Highway Council; Gravel Roads in Iowa, by Prof. T. R. Agg, Iowa State College; Inspection and Testing Road Materials, by Prof. Clark E. Mickey; Latest Developments in Concrete, by A. N. Johnson, Consulting Engineer, Portland Cement Association; Construction of State Highway Project No. 81 Concrete Road at Fremont, by Clark Brown, Project Engineer; Construction and Maintenance of Bituminous Macadam Pavements, by Prof. Geo. E. Martin, Barrett Mfg. Co.; Brick Paving, by Clark R. Mandigo, Chief Engineer, Western Paving Brick Mfg's Association; Financing County Paving, by Geo. Wolz, President Good Roads Association; Highway Program for 1920, by Geo. E. Johnson, Secretary Department of Public Works.

The Connecticut Society of Civil Engineers.

The thirty-sixth annual meeting was held at Charter Oak Hall, Hartford, Feb. 17-18. The importance of establishing the proposed National Department of Public Works and The Super Power line, both subjects continued from former meetings, were discussed, and papers presented on:

State Parks, by Albert M. Turner, Field Secretary, Connecticut State Park Commission.

Some War Time Developments in Electrical Communications and Allied Fields (Illustrated with lantern slides), by Dr. F. B. Jewett, Chief Engineer of the Western Electric Company.

Pictures in War, the Motion Picture and Its Unknown Part in Winning the War, by Jim Handy.

Stevenson Dam, by H. J. Hoard, Chief Engineer at Stevenson Dam.

Elimination of Grade Crossings, by F. Irvine Rudd, Engineer of the Public Utilities Commission.

Work of the State Board of Health, by Frank Bachman, Chemist and Engineer, Industrial Waste Department, Bureau of Sanitary Engineering, Connecticut State Department of Health.

A Quarry in Action. A novel exhibit of how a quarry is worked under modern methods, showing moving picture of The New Haven Trap Rock Company's quarry, North Branford, Conn.

Bridgeport Sewage Disposal, by James A. McElroy, City Engineer.

On the evening of Feb. 17 there was a dinner at the Hartford Club, and a reception to the newly elected officers, who are as follows:

Charles J. Bennett, Hartford, president; Thomas A. Scott, New London, first vice-president; J. Frederick Jackson, New Haven, second vice-president; Henry J. Kellogg, New Haven, secretary and treasurer; W. Howard Sharp, West Hartford, assistant secretary.

American Association of Engineers.

L. B. Hitchcock has been elected president and D. A. McClung secretary of the Phoenix, Ariz., chapter.

The following officers have been elected by the Lincoln, Neb., chapter; Geo. W. Bates, president; R. E. Davis, vice-president; Geo. K. Leonard, secretary.

Chapter charters have been granted in Carson City, Nevada; New Haven, Connecticut; Warren, Arizona; Delaware College, Newark, Delaware; Odgen, Utah; Trenton, New Jersey; Atlanta, Georgia; Carnegie Institute of Technology; and club certificates to petitioners from Santa Fe, New Mexico, and Utica, New York.

The board of directors has approved the amalgamation with the Michigan Engineering Society and constitution which, after adoption by the society, will provide for the establishment of the Michigan Engineering Society as a state assembly of A. A. E.

The plan of amalgamation with the North Carolina society, which recently voted to enter A. A. E., was also approved on a similar basis.

The membership of the American Association of Engineers on February 19 was 12,670. Applications during January, 2,025; during the first nineteen days of February, 757.

Associated Manufacturers of Water Purifying Equipment.

The annual meeting was held at the Bellevue Stratford Hotel in Philadelphia on February 4, 1920. Practically the entire membership was represented at a meeting of unusual progress and interest.

Born out of war-time necessity to assist in speedy production of water purifying equipment, the association now continues with the object of assisting in every way the water purification industry as a whole. Standard sizes for pressure filters have been agreed upon and the committee is also working on the standardization of contracts.

Arthur M. Crane, representing the New York Continental Jewell Filtration Company, was elected chairman for the year 1920, succeeding F. B. Leopold of the Pittsburgh Filter Company, who was elected to the Executive Committee to fill the vacancy created by the election of A. S. Garrett of the American Water Softner Company to the position of vice-chairman succeeding Mr. Crane. H. G. Tate, of the Borromite Company of America, remains secretary and treasurer.

Membership in the association is open to all firms, companies and individuals regularly engaged in the manufacture of water purification qeuipment, whether for filtration, softening or sterilization. It is the earnest desire of the association to have its membership include every organization covered in this classification.

American Concrete Pipe Association.—Convention was held Feb. 20-21 in the rooms of Western Society of Engineers and at the Great Northern Hotel, Chicago. The meeting separated into the Concrete Pipe Division under charge of J. E. Moody, engineer of the Massey Concrete Products Corporation, Chicago, and the Drain Tile Division, each of which held separate meetings.

PERSONALS.

Gannon, W. J., superintendent of Fitchbury, Mass., street department, died January 5.

Farrar, Frank E., is a candidate for Commissioner of Public Works, Farmingham, Mass.

Calhoun, John E., has been elected Highway Commissioner of Franklin, N. H.

Head, Orwin W., has been elected Superintendent of Streets of Concord, N. H.

Bingham, C. A., has been elected City Manager of Watertown, N. Y.

Jones, Richard A., for many years Superintendent of Streets, Waltham, Mass., has been retired with a pension.

Beal, Henry F., has been elected City Manager of Waltham, Mass.

Riddle, Karl, Abilene, Kansas, has been appointed resident engineer of federal aid road work in Dickinson Co.

Martin, George E., has resigned the professorship of Highway Engineering at Purdue University to become consulting engineer of the Barrett Co., Chicago.

Harris, W. B. has resigned as county engineer of Reno Co., Kan., to engage in private practice.

Walters, Chas. H., has been promoted to chief clerk and engineering assistant, New York State Engineers office, Albany.

Gilmer, D. E., has been appointed engineer of Reno Co., Kan.

Holway, W. R., has resigned as sanitary engineer, Department of Sewers and Water, Tulsa, Okla.

Mensball, H. A., has been appointed first assistant engineer of Kansas State Highway Commission.

Skougor, Hjahnar E., has opened an office as consulting industrial engineer. in New York City.

Belknap, Leslie, has been made chief engineer, Michigan State Highway Department.

Cot, W. W., has been made highway engineer of St. Clair County, Mich.

Baldwin, E. W., civil engineer, has opened a consulting office in Tulsa, Okla.

Scruggs, James D., is district manager of the Birmingham, Ala., office of the Richardson Phoenix Co., lubrication engineers and manufacturers, Milwaukee.

Hook, H. L., assistant engineer, Idaho Irrigation Co., has resigned to accept a position with the National Carbon Co., Cleveland.

Fulton, W. L., structural steel and reinforced concrete engineer, has opened an office in Omaha.

Sittinges, Carl J., is in charge of the John A. Stevens engineering branch office, Fall River, Mass.

Holbrook, Frederick, of Holbrook, Cabot & Rollins, contractors, Boston and New York, that have built many great public works, died at Paris, France, February 6.

Blakeslee, G. E., member of New Jersey State Highway Commission, died recently.

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

Blaw Forms.

For more than ten years units of sectional steel forms for the construction of light walls and foundations have been manufactured and sold by the Blaw-Knox Co., Pittsburgh, Pa., which although now somewhat improved in minor details are still substantially as at first designed.

They are built entirely of steel, the basis being a 24 x 24-in. unit reinforced with flange angles on all sides and through the center, and weighing about 22 lbs.

When assembled they are connected and held in alignment by keys, and are supplemented by fractional panels, lap panels and corner panels.

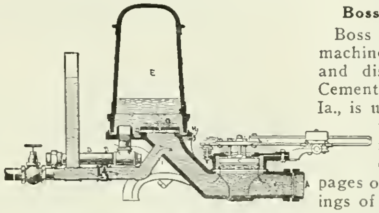
Bulletin 203 has a number of progress photographs showing the forms in position on many important jobs, and has several pages of description of the details of the forms and method of using them illustrated, with sketches and diagrams showing all of the practical operations.

Dumping Motor Trucks Automatically.

An automatic dumping device has been successfully applied to a United States Army motor truck now used by the New York State Highway Department. The truck body was disconnected from the under frame except by a hinge at the rear end and was furnished with a horizontal cross beam at the forward end. To the projecting end of this beam there were connected a pair of hinged struts 11 ft. long, one on each side of the truck. To dump the body, the lower ends of the struts are placed on the ground in advance of the truck and the truck being moved forward while the feet of the struts remain stationary, the latter are pulled into a vertical position, raising the forward end of the body high enough to dump its contents at the rear end, and as the truck advances the struts swing over to the opposite inclination from the vertical and lower the body to its original position on the truck frame, permitting the struts to be lifted up and secured or to trail along if the truck continues to advance.

Rife Hydraulic Ram

The Rife Hydraulic Engine Mfg. Co. issues a pamphlet descriptive of the Rife hydraulic ram suitable for pumping the water supplies for towns, houses, railroad tanks, irrigation and other purposes. It is a strictly automatic machine, operating on the water hammer principle, and can be employed wherever there are three or more gallons per minute available with a fall of 3 feet or more. It can be operated with dirty water to raise clear water which it can elevate to a maximum of 30 times as high as the operating fall. The largest ram in operation has a 5-inch discharge pipe, weighs 3,000 pounds and develops from 66 to 92 per cent efficiency.



RAM WITH ATTACHMENT FOR RAISING CLEAR WATER BY USE OF DIRTY WATER.

Discharge valve C being open and check valve O being closed, water delivered through drive pipe A escapes through valve C until the diminishing pressure closes it, and the pressure of the moving column of water in pipe A opens valve O in bottom of air chamber E, and water enters, and compresses the air in the chamber until equilibrium is established, the valve O closes, valve C opens enough to permit a small discharge of water and again establish the flow in pipe A and so on, the water being delivered from the air chamber E through the outlet pipe D, under pressure to the tank or receiver.

If it is required to operate the ram with dirty water and elevate clear water from another source, the clear water pipe I is connected to the drive pipe A just below valve O, and water from it passing through a check valve, rises to valve O and is forced into the air chamber without being followed by any of the dirty water. A small automatic valve at H constantly admits air that refurnishes and maintains a supply in chamber E. This ram is recommended for use with a pneumatic tank which provides continuous pressure on a closed supply system. The rams are simple and durable in construction, and easily accessible for maintenance and adjustment. They are easily installed and are manufactured in nine sizes requiring from 2 gallons to 650 gallons per minute for their operation.

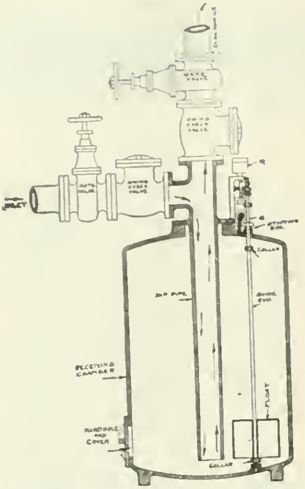
Boss Construction Machinery.

Boss labor saving construction machinery designed, manufactured and distributed by the American Cement Machine Co., Inc., Keokuk, Ia., is used by more than 6,000 contractors and is attractively illustrated and described in catalog 920 by sixty-four pages of diagrams, half-tone engravings of equipment and other operations, supplemented with descriptions and specifications of concrete mixers and mortar mixers, sizes one-half bag to four bags; one and two bag pavers; single drum, double drum and traction hoists; backfillers, material elevators, diaphragms, trench and force pumps, air compressors, saw outfits, and concrete carts, all warranted.

Simplex Sewage Ejectors.

The inlet of the ejector is connected to the lowest point of the drainage system and the sewage passing by gravity through the gate and check valves and stand pipe enters the bottom of the main chamber, raising the copper float and guide rod until the latter operates weight Q and opens the air valve. This admits pneumatic pressure from a storage receiver to the top of the ejector chamber and forces the sewage back up the central stand pipe, closing the lower check valve and delivering the sewage through the upper check valve and gate valve to the discharge pipe. When the sewage is nearly all discharged from the ejector chamber, the dropping of the float valve closes the air inlet valve, the check valves are reversed, opening the inlets and closing the discharge pipes, and the cycle of operations is repeated.

The ejectors are installed as



VERTICAL SECTION SHOWING FLOW IN AND OUT OF COMPRESSION CHAMBER.

single or as duplex units and are provided as required, with air receivers, air compressor and automatic control. They are furnished of any desired capacity up to 1,000 gal. per min. and to operate against heads up to 250 ft. The normal speed of operation is one discharge per minute. These machines are recommended for ejecting sewage from basements at elevations below the level of the street sewer; for raising the sewage in low-lying districts to the main sanitary sewer; for increasing the velocity of flow in existing sewer systems, for handling raw sewage or settled sludge at sewage disposal plants; and for the automatic raising of any kind of fluid, semi-solid or gritty solution.

Lane Electric Cranes.

A new bulletin, entitled "Lane Electric Cranes," has just been issued by N. B. Payne & Co. It illustrates and describes several styles of cranes in which steel girders or heavy timbers of long leaf yellow pine are used. A record of thirty years is claimed for this crane—minimum power and repair cost and great overload capacity. The cranes can be operated by inexperienced labor.

The Pennsylvania State Highway Department will, in 1920, operate their own stone quarries and sand banks under the direction of a new department headed by D. M. Hepburn, Philadelphia.

INDUSTRIAL NEWS

T. L. Smith Company Sales Manager

R. E. S. Geare has been appointed general sales manager of the T. L. Smith Company of Milwaukee, manufacturers of concrete mixing machinery and contractors' equipment. He will be in charge of the company's general sales offices, Old Colony Building, Chicago, where the advertising and sales departments are now located.

For the past four years Mr. Geare has operated under the firm name of Geare & Co., engineers, specializing in sales engineering in the construction and power plant field. Geare & Co., handled the business for the T. L. Smith Company, the Mainstee Iron Works and others.

T. L. Smith Company manufactures the Smith Simplex paving mixer, the famous Smith tilting mixer, non-tilting mixers, pumping machinery, tower equipment, etc.

General Contracting.

The Freeland, Roberts Co., capital stock $25,000, has been incorporated at Nashville, Tenn.

River Improvements.

The Submarine Engineering & Construction Co., Troy, N. Y., has been incorporated with $50,000 capital stock.

Waldo-Bond Consolidation.

The long established firm of Waldo Brothers, Inc., and the Harold L. Bond Co. have recently consolidated in the Waldo Brothers & Bond Company, Boston, dealers in construction equipment and building materials. This arrangement combines two important factors, providing for all kinds of engineering construction requirements, and will cover very nearly the entire field of the general contractors' purchases. The new organization will continue the activities of the old elements, to give a complete service to the contracting and building industry of New England.

Since its inception, eighteen years ago, the Harold L. Bond Co. has developed a large business in engines, hoists, pumps, drills, concrete machinery and general power and hand tools. The Waldo Brothers Inc., commenced business fifty years ago and have been notably successful in the introduction, manufacturing and distribution of Portland cement and in handling bricks, tiles and other building materials.

The new concern will handle and distribute everything necessary for the construction and equipment of buildings and for other important construction work, including nearly all kinds of manufactured building supplies and contractors' plant and equipment. It will issue a new house organ called *Construction Service* for the presentation to the trade of interesting and helpful articles and pictures of current construction jobs, information regarding new equipment or materials, pertinent news articles and editorial comments.

Holway Engineering Co.

W. R. Holway, recently sanitary engineer, Water and Sewer Department, Tulsa, Okla., and formerly with the Water Supply Board, Providence, has organized the Holway Engineering Co., Tulsa, Okla.

Storage Dam Contract Approved.

A tentative contract between the United States and the canal companies and irrigation districts interested in the storage of the Snake river water in Idaho has been approved by Secretary Lane. Plans now being worked out provide for the construction of numerous storage dams. At American Falls it is proposed to construct a high dam across Snake river, creating one of the largest irrigation reservoirs in the United States.

The approaching utilization for irrigation, of a large part of the most available water supply in California indicates that it will soon be desirable to conserve the flood waters of mountain streams, and that the great cost of the impounding reservoirs will necessitate Federal construction, which, wisely conducted, should be quickly repaid by the beneficiaries.

Earth for the embankment of a 100-foot dam in the Happy Valley Irrigation District, Shasta County, Cal., is excavated from the hillside by an hydraulic giant which washes it into a wooden flume carrying it across the valley on a trestle viaduct.

The Cleveland Traction Commissioner, Fielder Saunders, asks for a $2,500,000 bond issue to provide funds to purchase 100 additional cars and trailers; to replace five cars "which are now too small"; to revise power distribution in the interest of efficiency. Three new substations should be built; to double track Clark avenue line. Link Clark avenue and Union avenue lines by tracks on Pershing avenue and operate as crosstown lines; and to construct new cross town line in W. 117th street.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

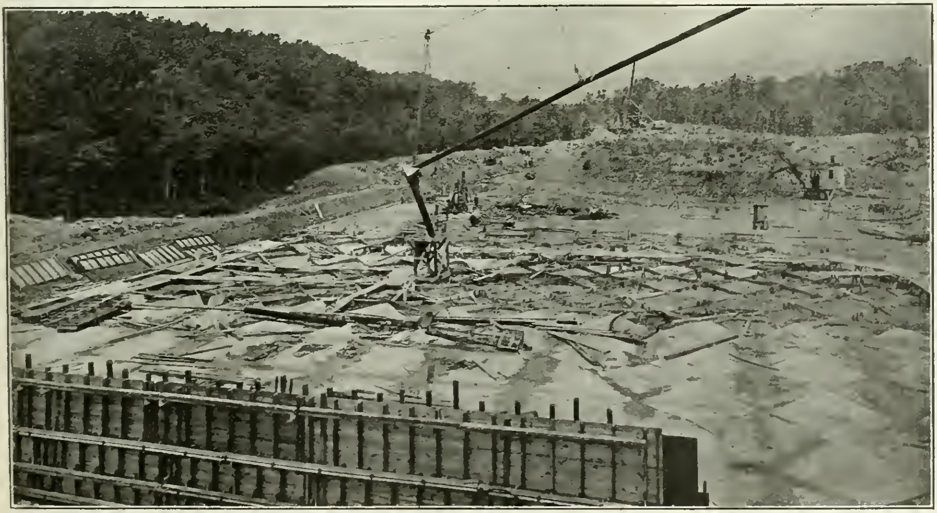
Vol. 48 NEW YORK, MARCH 6, 1920 No. 8

Building the Hartford Filter

Methods and plant used by the contractor in building a slow sand filter covering five acres and roofed over. Special trolley line for delivering materials to site; concrete distributed entirely by spouting; collapsible roof forms used eight times.

The water works of Hartford, Conn., are among the oldest in the country, and the extensions and improvements made during the past three or four years have been among the most extensive and important of those made by the larger cities of the country during recent years. Prior to 1855 there had been a small water works system owned by private parties, but in 1855 a municipal plant started operation under a Board or Water Commissioners. This system pumped water from the Connecticut river, which source was used until a gravity supply was put in operation in 1867 by storing water from Trout brook. The gravity supply was enlarged from time to time, but by far the greatest increase was that put into use about two and one-half years ago, with the completion of the Nepaug reservoir. This reservoir has an impounding capacity of nine and one-half billion gallons and a water-shed of thirty-two square miles—more than twice the area of the water-shed formerly drawn upon.

This reservoir, completed in 1917, solved for many years to come the problem of quantity of supply. The quality, however, could not be considered entirely satisfactory, since all of the water came from surface flow and streams, and the plans which have been under development for several years past included the filtering of the entire supply. The plant for effecting this is well along toward completion. It consists of four acres of slow sand



ARRANGEMENT OF FORMS, DELIVERY OF CONCRETE THROUGH SUSPENDED CHUTE AND DISTRIBUTION BY CARTS FOR FLOOR OF FILTER SECTION filters designed to operate at the rate of five million gallons per acre. The twenty million gallons so provided for are abundantly ample for the present, the average daily consumption being about twelve million gallons; but to provide for the future, land was secured and arrangements made for constructing another filter of equal capacity adjacent to this one. The estimated cost of the filter now under construction is about $600,000.

THE FILTER STRUCTURE.

This structure is built of reinforced concrete, with a a groined roof, groined floor, vertical columns and side walls. The exterior dimensions are about 572 feet by 350 feet by 14 feet high. The columns are 13 feet apart on centers, longitudinally and transversely, and are 20 inches square, without reinforcement. The roof has a minimum thickness of about 6 inches and is reinforced only adjacent to the outer wall.

The outer wall has a thickness of 2 feet, 9 inches at the base, tapering to 2 feet at the top, with vertical inside face, and is reinforced with vertical twisted bars.

The filter is divided into eight duplicate rectangular units in two rows of four each, each unit being enclosed by division walls common to both. Each unit is about 143 feet by 169 feet, being divided into eleven panels one way and thirteen the other way.

The filter is constructed on an approximately level site, which was excavated from six to eight feet to sub-grade, principally on solid rock.

The principal quantities involved are:

32,380 yds. of concrete
300,000 lbs. reinforcement steel
42,600 yds. earth excavation
8,800 yds. rock excavation
17,000 yds. rolled embankment
34,500 yds. back fill
32,000 bbls. Portland cement.

The contract price for the reservoir was about $600,000 with

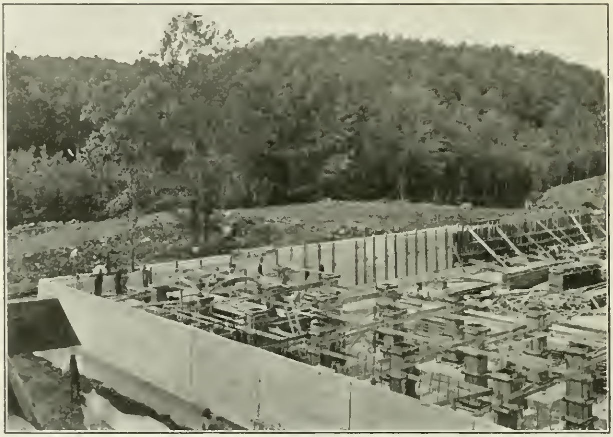
Earth excavation at	$ 1.00	
Rock excavation at	5.00	
Class "A" concrete	14.00	cu. yd.
" "B" "	7.50	" "
" "C" rein. concrete	13.50	" "
" "D" concrete not requiring forms	4.00	" "
Rolled embankment	1.10	" "
General fill	.80	" "

As it was realized in the beginning that considerable difficulty would be involved in delivering plant and materials, the contractor built about 3,000 feet of standard-gauge trolley track from West Hartford to the site, where the end nearest the filter was carried on 400 linear feet of four-post timber trestle, 18 feet high.

On this track there were delivered during the progress of the work all materials and the contractor's plant and equipment. The road was built in about six days by the contractor's forces.

A Thew and an Erie steam shovel, with 7/8 yard buckets, were installed for the excavation of the loamy earth and the rock, after the latter had been shattered. They delivered the excavated material to two-horse bottom-dump wagons, by which it was transported a maximum distance of 200 feet and deposited in bunkers and on the rolled embankment, the former being later used to make a large percentage of the back-fill, the remainder of which will be furnished from an adjacent borrow pit.

A battery of three boilers and two air compressors was installed in a central plant, to furnish power for about six Ingersoll-Sargent tripod drills used in the excavation work. The same plant distributed steam around the site for two derrick hoists, also to operate concrete mixers and supply pumps and operate the saw milling plant.

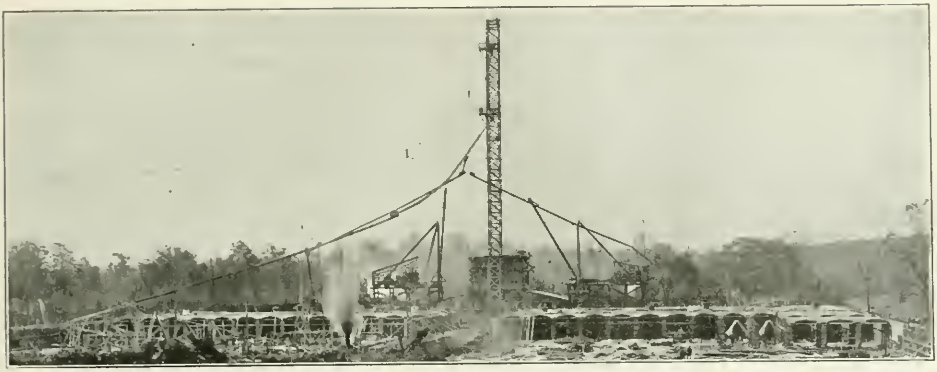


FORMS FOR SIDE WALLS AND COLUMNS

CONCRETING EQUIPMENT.

Sand and gravel purchased from the producers were delivered over the trolley line and unloaded from dump cars on the trestle to storage piles on the ground below. A stiff-leg derrick and clam-shell bucket delivered the aggregate from the storage piles to bins, which had capacities of 500 yards of gravel and 300 yards of sand. Each bin had two sliding gates in the hopper bottom at an elevation of about 20 feet above the surface of the ground, thus enabling them to deliver directly to the charging hoppers of two one-yard Lakewood concrete mixers installed on a platform about 8 feet above the surface of the ground. Cement, also delivered over the trolley road, was stored in a shed of 2,500 barrel capacity adjacent to the mixers in the bins, and was placed by conveyor in the charging hoppers.

The two mixers discharged through a common spout to the hoisting bucket under the foot of a wooden tower 176 feet in height that had its foundation sills in the bottom of a pit about 5 feet



CONCRETE MIXING, HOISTING AND SPOUTING PLANT AND ELEVATED DERRICKS.

deep. The tower was about 8 feet square and was assembled complete in horizontal position on the ground and revolved into position with two derricks, the cables being attached to the tower with a bridle. The tower is guyed at the top and center points with four guys at each point, anchored to trees and deadmen. The tower was located close to the filter on the center line, and supports a main cable in the plane of the center line, running the full length of the filter, with transverse cables supported by it over the center of each unit. The ends of these cables are anchored to trees, or to deadmen consisting of inclined stakes. From the main and transverse cables, ½-inch manila tackles are suspended about 16 feet apart to carry the Lakewood chutes through which the concrete is spouted to required position.

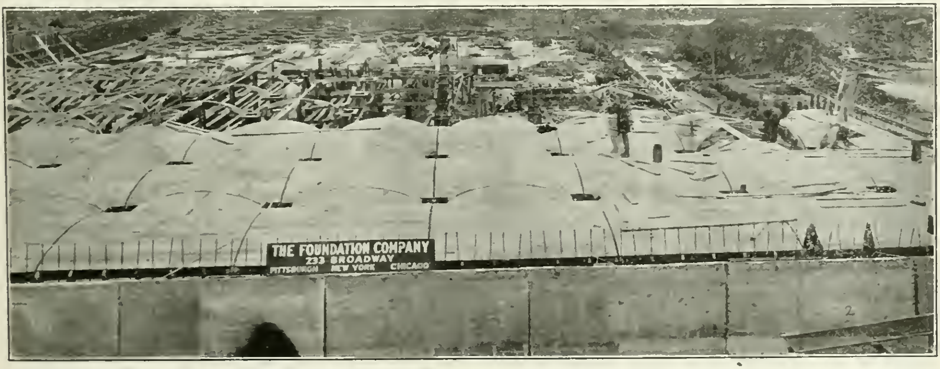
The first four units were supplied from a receiving hopper located near the mid-height of the tower and the last four were supplied from the hopper at the top of the tower. The concrete mixers were of the Lakewood type.

CONSTRUCTION OF FILTERS.

The invert was designed of the shallow, reverse groined type, in order to provide drainage and location for the half-pipe collectors. Each panel, 13 feet square, sloped from the summit, where the column is seated, to the center point or invert line.

The invert was made in two operations, the first of which consisted of the construction of diamond-shaped areas, having their transverse diameter at the low point, with the apexes of the opposite diameter at the bases of the columns. These sections were constructed simultaneously in longitudinal rows across the full width of each filter unit, several adjacent rows being built simultaneously.. They were made with vertical wooden side forms having inclined upper edges to which the surface of the concrete was screeded with wooden straight edges and afterwards troweled. These preliminary sections inclosed between them corresponding open diamond-shape areas, which were later filled with concrete screeded with a recess joint, which was afterwards asphalted. The spaces between the first sections of the invert were filled with concrete that was screeded with straight edges worked on the old concrete. At the corners of each finished panel, horizontal recesses were left to receive the vertical columns, which were built in ordinary knock-down wooden forms.

The roof forms were each portions of a cylindrical arch, 13 feet long and 13 feet span, intersected



SUPPORTS FOR CONCRETING GROINED ROOF ARCHES. IN BACKGROUND LAGGING STRIPPED TO EXPOSE RIBS AND SHORES.

by a duplicate arch at right angles at the center point, making the lagging consist of two triangular cylindrical surfaces joined at the apex in the center of the panel. These were supported on the column forms, and after the latter had been removed the horizontal ties, or lower chords, were removed and the ribs of the forms collapsed at the hinge, permitting them to be disengaged and lowered to a support on the tower of a car, which transferred them to another panel, where they were adjusted for service. Each form was made with two ribs intersecting at an angle of 45 degrees at the center. Enough forms were built for one full unit at the contractor's shop, which was equipped with a planer, rip-saw, cut-off saw, cutting machine, boring machine, and a band-saw. About thirty form builders were employed in making, shifting and repairing the forms. About 40,000 feet board measure was required for the forms and shoring, 10,000 pounds of iron work, and 350 gallons of crude oil, with which the form was painted each time it was used. The forms were used eight times. The concrete delivered from the tower to the main-line chutes and the main transverse chutes, was distributed from the latter through line gates and 16 or 32 feet lengths of movable chutes, thus eliminating all wheeling or hand labor of distribution. The upper surface of the roof was screeded to the cylindrical soffits of the groined arches.

Especial attention was paid by the contractor to the design and construction of the forms, which are believed to be cheaper, lighter and more durable than often found in such work.

The work was executed by an average force of 100 to 150 men, who are also constructing the aerator, the regulator houses and the laboratory and pipe lines.

Owing to the scarcity and poor quality of labor, the contractor established a camp, with houses, commissary storehouse and the usual adjuncts for sanitary and social requirements, and secured forces largely from the vicinity of New York, after which the turn-over was considerably decreased.

The contractor for the work is the Foundation Company, of New York City. The filters were designed and are being built under the direction of Caleb Mills Saville, chief engineer and general manager of the Board of Water Commissioners.

Encouraging Timber Estimate

The National Lumber Manufacturers Association says that "of the two trillion eight hundred billion feet of standing timber now in the United States, according to the best available figures, nearly one-half is in the Pacific Coast forests, somewhat over one-fourth in the southern forests, one-ninth in the central forests, one-ninth in the Rocky Mountain region and about one-tenth in the northern forests.

Washington and Louisiana are the greatest lumber-producing states of the union, the former producing four billion and a half board feet of lumber in 1916, and the latter four billion two hundred million. Missippi and Oregon follow with 2,700,000,000 and 2,200,000,000 feet, respectively, and Oregon, Texas, Arkansas and North Carolina produced each about two billion feet in 1916.

It is possible, the Government says, that its estimate of two trillion eight hundred billion feet is too low and that this may not represent half the actual amount. If the figures given are correct it would take sixty years to deplete our forests entirely: if the actual amount is twice these figures, it would take over one hundred years and this on the basis of no new growth at all. Very good commercial trees may be grown in sixty years so that the timber supply in this country is practically inexhaustible with moderate care, reasonable protection, especially as regards fire and insect ravage, and moderate re-forestation."

9,000-Ton Concrete Pump Well Constructed Floating

The 96x45-foot concrete pump well 60 feet high for the Pearl Harbor Dry Dock at Honolulu was built by the San Francsco Bridge Co., floated to place, and sunk to final position on a deeply submerged foundation by the use of a floating dry dock in which the construction was commenced, and a detachable wooden cofferdam that permitted the remainder of the concrete to be placed after the lower portion, temporarily serving as the bottom of the cofferdam, was removed from the dry dock and remained floating.

The pump well is a rectangular reinforced concrete box with solid floor and open top and is divided into five large and five smaller chambers by one longitudinal, and four transverse interior concrete walls integral with the exterior walls and floor.

The floor, 3 feet thick, and all of the walls up to a height of 18-feet were concreted in forms installed in a 3,500-ton wooden floating dry dock that had previously been used in the construction of the Pearl Harbor concrete grading dock. Brackets and extensions to the exterior walls, 17 feet above the bottom provided support for bottom sills on which, while the lower portion of the pontoon was in the dry dock, there was erected a sectional detachable wooden cofferdam with interior dimensions of 48 feet 8 inches x 100 feet 2 inches and a height of 40 feet. The cofferdam was braced with six courses of longitudinal and transverse horizontal struts dividing it into 21 interior panels clear of the inner faces of the outer walls, and 24 smaller exterior panels formed by the extension of the braces through the permanent outer walls to the sheeting.

The longitudinal and transverse struts cleared each other with their adjacent horizontal surfaces in the same planes and were supported at intersections by vertical struts. The framework was trussed by X-braces in panels or groups of panels between the vertical struts and between the horizontal members.

Stockton, San Joaquin County, Cal., is considering plans for Harbor Improvement of an estimated cost of about $4,000,000 that have been prepared by S. A. Jubb. The items include channels for light and deep darft ships, municipal railroad yards, a belt line railroad and the excavation and removal of the Weber peninsula.

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FRANK W. SKINNER, *Associate Editor*

Co-ordinating Big Construction With Finance

The project of a great municipal water supply and power development for the city of San Francisco ranks among the most difficult, extensive and costly of its kind, and now after considerable delay, due to war conditions, is being prosecuted with vigor and able executive, engineering and financial direction that assure successful completion betimes of an almost unprecedented undertaking that has been in progress for nearly twenty years, and was just commencing its physical development at the beginning of the world war.

As outlined on page 165 this great aqueduct and appurtenances for the ultimate supply of more than four hundred million gallons of water daily, plus the development of 250,000 horse-power of electrical energy at a cost of about forty-five million dollars, is directly comparable with only two other finished works and is exceeded in cost by only one.

The collection and storage of this great volume of water at an elevation 3,500 feet above the city and its delivery by a conduit 68 miles long was made possible by an act of Congress giving the city 420,000 acres of public land, and by the municipal authorization of 45,000 4½ per cent $1,000 bonds, maturing in successive years from 1922 to 1964, which are being sold as necessary to provide construction funds.

A masterly investigation of the engineering conditions and requirements determined the advantages and ultimate economy of expending several million dollars in auxiliary construction to expedite and cheapen the necessary work on permanent construction, and to this end 68 miles of standard gage mountain railroad was built for the transportation of materials and equipment needed on the work; a large storage dam and ten miles of natural and artificial conduit were built to provide water for a 4,500 horse-power hydro-electric plant to operate construction machinery for the permanent works, timber land was secured, a saw-mill put in operation and a force of about 500 men organized to operate them. This has provided not only for the construction of necessities, but for commercial business that has already resulted in a revenue from the railroad and an income of more than $67,000 from the power plant during the year 1918-19.

The permanent work has been classified in ten great divisions, three of which, the construction power plant, the main dam, and the twenty-mile mountain tunnel are already under construction with a total present force of about 800 men. The manner in which this work is being conducted so as to utilize natural forces, develop the greatest potential value from the system and distribute the financial burden in the easiest and most advantageous manner, is highly creditable to City Engineer M. M. O'Shaughnessy and the other officials and associates responsibly associated with it. The largest auxiliary item is the railroad, a financial, construction, and economic success described in the first of a series commenced in this issue.

Return of Railroads Good For Construction

The return, March 1, of our $20,000,000,000 railroad system to private control is of the utmost potential advantage for national prosperity, construction interests and activities, the reduction of the high cost of living, and restoration of the value of the dollar. The extravagant and arbitrary management, drastic measures enforced, great depreciation of property permitted, discrimination against specific interests, and, above all, the low morale developed under government management, have affected the greatest, most intricate, and one time most marvelously efficient system in the world in a way that has been so patent that the whole nation, except the railroad labor profiteers, is strong for a return to the old condition.

This will take time and, it is authoritatively estimated in the Railway Age, the expenditure of about $6,000,000,000 within the next three years to make good as much as possible, the deterioration now existing. This will of course involve increased freight rates that should be accompanied by a scaling down of wages and an enormous increase of efficiency in the personnel, features which no reasonable critic can object to in view of the fact that the operating expenses of the roads have increased 102 per cent since 1914, while freight rates have been increased only 34.4 per cent, and more men do less and poorer work in more man-hours at higher pay.

The combined necessity and opportunity for earning profits will be a great factor in the increased and improved service to shippers and it will be found that construction materials and equipment will not be unnecessarily discriminated against so that engineering operations of all sorts can go on with much greater speed, economy and certainty.

The expenditure of $6,000,000,000 in three years means the execution of a vast amount of long delayed reconstruction and new construction, involving great quantities of all kinds of heavy construction work, equipment, and materials—a prospect that is highly satisfactory for big and little contractors and at the same time constantly facilitates the construction and operation of every other kind of public work. The high cost of our experiment in government controlled railroads will be partly offset by the great impetus it has given to the development of motor truck transportation and the economic lesson to the public.

Safe Pile Loads

Hardly any factor of design is so uncertain as the safe bearing capacity of foundation piles that is influenced by many conditions, most of them unknown in advance, difficult to determine and often subject to change without apparent cause or indication. The necessity of absolutely reliable foundations for all important structures is increased by the fact that the foundations are generally the most inaccessible portions of the structure, and are difficult to test or inspect. Any serious failure in them is likely to endanger all the rest of the structure even to the point of destruction or of repairs that may easily amount to many times the original cost of the foundation and may also involve new foundations or modifications of old ones that are exceedingly difficult, uncertain and costly to make.

The only safe practice is therefore a highly conservative one, using a large factor of safety, or as the late Theodore Cooper aptly termed it, "factor of ignorance."

Excepting where comparatively short piles are satisfactorily seated on solid rock or very hard stratum and the piles act as simple columns there are few cases where the bearing strength can be at all accurately determined, even at first, or where it may not be subject to serious change, often due to unsuspected changes of conditions. The lowering of ground water level by natural or artificial causes; adjacent building or excavating operations; impact; vibration; deterioration of the pile material, and various other causes may operate to greatly reduce it, so that a large margin of safety should always be allowed whenever there is any uncertainty as to conditions, and excessive loads should never be permitted.

Preliminary explorations by test holes and pits should be made where conditions permit, and where large numbers of piles are used, their length, size, and number, should be largely determined by the results of test piles driven and loaded in advance, and accurate records made of their settlements and penetration under impact and static loads.

For 12-inch piles, not less than 3 feet apart, driven to a penetration of 15 feet or more in ordinarily firm soil, the ordinary maximum load of 10 tons should not be carelessly exceeded, and in some cases, should not be allowed.

No element of the piles load capacity is more uncertain than the resistance to settlement due to skin friction which varies many hundred per cent with the character of the soil and other factors. In very soft mud where a long pile will often penetrate 20 or 30 feet under its own weight alone, skin friction is rapidly developed after a pile comes to rest and in the course of a few hours may often be so great as to resist displacement by heavy impact that would previously have caused many inches penetration. This fact, the difficulty of sinking undermined caissons that are held up only by skin friction, the difficulty of pulling piles, and other reasons have produced in many quarters an exaggerated estimate of the value of skin friction that may be properly used for proportioning the pile load. Some practical features of the skin friction actually existing on piles in service are given in the valuable extract, page 173, from a paper based on many years of experience of an eminent construction engineer with earth pressures and resistancies that demonstrates the necessity for very conservative assumptions.

Increase Efficiency, Energy and Economy

We can no longer be content with easy going efficiency. Every kind of useful efficiency must be doubled, trebled, and multiplied. Labor, art, science, commerce, education and even politics must greatly increase the time and intensity of their efforts. No 6-hour, 8-hour, or even 10-hour day's work suffices. We must work as long and as hard as considerations of health, strength, and public welfare permit, multiplying and improving our production and making up this tremendous deficit. Even so, with the wonderful improvements and conveniences afforded by science and machinery our comforts and luxuries, our privileges and enjoyments will be infinitely greater and our hardships incomparably less than those of our pioneer forbears of only three or four generations ago.

In these things contractors play a leading part. Wise economy and resistless energy will build great works that are otherwise impossible and open tremendous fields for production by other classes. They will make work where work is now absent or hesitating. They will make profits where old methods and habits show only loss and they will bring strength and prosperity to every kind of necessary construction in all parts of this country, if every man will simply concentrate the utmost energy and determination to increase construction work of every useful kind, to make opportunities for it, and fill them, to economize wisely in time, in labor, in materials, and in every other item to the extent of increasing efficiency and eliminating all waste and extravagance. The first and biggest consideration is to have no lost motion, no lost time, no lost labor, no wasted materials, no lack of co-ordination, no lack of preparation, and no lack of skilled control. It means careful planning, the selection and education of labor, the survival of the fittest, reward of success, punishment for failure, ingenuity and originality in design and in the selection of material. Above all, it means economical and therefore large scale work, in every case accomplished by power and by the highest class of machinery that will work day and night incessantly without Sunday, holiday, or strike interruption. This will pay a large return on the investment and conserve human intelligence and adaptability for special operations.

Inevitable Results

Philadelphia's wage scale increased 120 per cent in 1918 over 1917, while the value of production in all classes of industry increased 30 per cent, according to M. Hoke Gottschall, of the State Department of Internal Affairs.

The value of Philadelphia's products for 1918 is placed at $1,913,852,400, as compared to $1,559,148,200 in 1917. This shows a reduction of about 6 per cent in the actual volume of production to correspond with the enormous increase of wages.

Hetch Hetchy Water Supply—I

154-mile aqueduct and auxiliaries for ultimate delivery of 400,000,000 gallons daily to San Francisco at estimated cost of $45,000,000. Preliminary work, more than $2,000,000. Construction of railroad 68 miles long, requiring 1,000,000 yards of excavation and having four per cent grades and 30 degree curves, built by the city of San Francisco.

In 1914 preliminary work was commenced on the construction of a water supply system for the city of San Francisco that it is estimated will be completed in 1923 at a cost of about $45,000,000. Notwithstanding the difficulties, increased expense, and interruptions caused by the war, and the uncertain conditions of the labor and material markets the work has been prosecuted vigorously and much important construction has already been accomplished at a cost of about $8,000,000 expended up to Nov. 1st (including about $2,000,000 for lands, water rights and early investigations). Most of the preliminary and auxiliary work has been completed, many of the important operations and principal constructions for the aqueduct and main dam are now in progress.

The present time is therefore suitable for a review of the general features of the completed work and descriptions of the methods that have been adopted and the plant that has been installed on it, and for the current work, essential features of which will be described in the present and succeeding articles timed to present a connected outline of a large part of the principal construction at the most advantageous period.

SIZE AND IMPORTANCE.

The Hetch Hetchy system, one of the greatest and most difficult of its kind in the world, is closely comparable with only two others, both of them very recently completed at enormous costs.

The Los Angeles aqueduct, 223 miles long, includes about 63 miles of canals, 98 miles of covered conduits, 43 miles of tunnels, 12 miles of steel and concrete syphons, and has cost about $27,000,000. The aqueduct is designed to afford a supply of 260,000,000 gallons daily, for an ultimate development of 49,000 h.p. and was built and put in service in about six years.

The principal elements of the Catskill Water Supply for the City of New York are the 128,000,000,000 gallon Ashokan Reservoir that delivers 250,000,000 gallons daily through an aqueduct 92 miles long including 55 miles of cut and cover concrete structure, 31 miles of tunnels and 6 miles of steel pipes. Inside the city limits are, in addition 18 miles of pressure tunnel and 14 miles of pipe. The construction was substantially completed in about 8½ years at a total cost of about $136,000,000.

Both the Los Angeles and the New York Supplies have been executed with the latest development of engineering and construction methods, operations and plant. A third great system, the Metropolitan water supply system for Boston and neighboring cities, has been completed and in successful operation for a number of years but the developments and methods involved in its construction were not so far advanced or so closely parallel, as those of the other systems are with that of the San Francisco system.

THE HETCH HETCHY SYSTEM.

The investigations for the Hetch Hetchy system began nearly 20 years ago and some of the features eventually adopted were presented in the Grunsky Report of 1902 for an ultimate supply, by combined pumping and gravity systems, of 160,000,000 gallons a day through an aqueduct 182 miles long. Various modifications were subsequently proposed that ultimately resulted in the adoption of the present plan providing for an ultimate supply of 400,000,000 gallons a day in the Tuolumne water shed and its delivery to the city limits through an aqueduct 154 miles long.

TAMPING BALLAST IN CONSTRUCTION OF HETCH-HETCHY RAILROAD.

It also provides for the ultimate development, on the line of the aqueduct, of about 200,000 hydroelectric h.p. The water will be delivered entirely by gravity. The tunnels of the aqueduct will be designed for their ultimate capacity of 400,000,000 gallons a day while the pipe siphons across the broad valleys will have an initial capacity of 60,000,000 gallons a day, provisions that contemplate enlargement and additions as required and a large ultimate economy by saving interest charges.

The main impounding reservoir is formed by the construction of the great Hetch Hetchy dam across the gorge of the Tuolumne River at a point high up in the Sierra Nevada Mountains about 150 miles east of San Francisco. From this point the flow will be for 12 miles through the original river channels, thence through 66 miles of tunnels 10 feet 3 inches in diameter, and 88 miles of steel pipes whose sizes have not yet been definitely determined, but will be probably 5 feet to 5½ feet in diameter.

In its early stages the plan was subject to continued and violent opposition and the location of the system, mostly at a high altitude in very rough and mountainous uninhabited regions, inaccessible at first by any means of rapid, efficient communication or transportation, greatly increased the difficulties, expense and necessary time of construction. To meet these difficulties and provide for the most economical construction and maintenance and for the absolute safety and continuity of operations in the finished structure, unusual care was exercised in the design not only of the permanent structure but of the auxiliary and temporary structures and of the methods of construction that were intended to utilize potential resources and advantages and the most advanced practise and resources of the various engineering construction problems involved. The general features of the system were described and a topographical and sectional map showing the principal structures was given in the Municipal Journal Vol. 45, page 223, Sept. 21, 1918.

PRINCIPAL AND AUXILIARY CONSTRUCTION.

The most important and difficult part of the work consists of the Hetch Hetchy impounding dam and reservoir; the 18-mile main tunnel under continuous high peaks of the Sierra Nevada range; the main power house on the conduit, and the pipe line connecting the latter with the tunnel, together involving an outlay estimated about $20,000,000.

GRADE OF MOUNTAIN HIGHWAY NEAR LINE OF AQUEDUCT AND RAILROAD.

The Hetch Hetchy dam of Cyclopean concrete is to be a gravity section, arched in plan, with deep foundations on solid granite rock and ultimately 312 feet high above stream level. Initially it will be constructed to a height of 226 feet above stream level, at a cost of $6,000,000 and should be completed to this initial height in 1922.

From the dam to the east portal of the main tunnel, water supply will be delivered through about 12 miles of the original channel of the Tuolumne River. Near the east portal there will be eventually established, at Early Intake, a power house to be connected with the Hetch Hetchy dam by 12 miles of pressure tunnel aqueduct, and a battery of steel pipe penstocks.

From Early Intake to Priest the water supply will be carried through a hard rock concrete lined tunnel 10 feet 3 inches in diameter and 18.3 miles long, of which the two main portions passing far below the summits of the peaks are connected by a short steel conduit crossing the south fork of the Tuolumne River between two high mountains. This tunnel descends 150 feet in its entire length thus conforming closely to hydraulic grade, and discharges into a regulating reservoir from which the water descending about 1,300 feet passes through a tunnel, a reinforced concrete conduit and steel pressure pipes to the Moccasin Creek power house of 66,000 h.p. capacity, and is then conveyed to San Francisco through about 69 miles of tunnel and 67 miles of steel conduits. By the completion of Moccasin Creek power house, the electrical energy available for San Francisco will be more than doubled. This will aid the industrial development of the city and the bay communities, which are now seriously hampered in their growth by lack of water and inadequate supply of power. Shipbuilding and manufactories of every description will be greatly stimulated.

FUTURE POWER UNITS.

An output exceeding 250,000 horsepower will ultimately be developed on the Hetch Hetchy project by dropping the water from the higher levels 8,000 to 10,000 feet altitude to the domestic supply terminal at Priest's, 900 feet above the sea level, as the city controls a watershed for its exclusive use of 416,640 acres, with an average runoff of two and one-half feet per year, which yields 1,041,600 acre-feet annually.

In order to transport plant and materials to the line of the work, the city has built a construction railroad about 68 miles long, connecting the Hetch Hetchy dam with the Sierra railway at a cost of about $2,000,000.

To provide electric power for construction operations, a preliminary hydroelectric installation has been built with a power house near the east portal of the main tunnel, at Early Intake with 4,000 h.p. capacity and transmission lines extended in both directions, one to the Hetch Hetchy dam and the other across the mountains paralleling the main tunnel to Priest.

Water under pressure to operate the turbines in the power house is derived from a reservoir constructed by building an impounding dam across the Eleanor creek to maintain the service in dry seasons and by conducting the water through Eleanor creek and Cherry River to a diversion dam and through an aqueduct consisting of tunnels, open canal and flume that delivers water with a head of about 346 feet to the power house, the whole installation, including Eleanor dam and the transmission lines, having been built at a cost of approximately $800,000. The Eleanor dam and the aqueduct will remain permanent features of the project.

HETCH HETCHY RAILROAD.

The 1915 report of M. M. O'Shaughnessy, chief engineer of the City of San Francisco, estimated that there would be required for the construction of the Hetch Hetchy dam and the upper tunnel aqueduct 233,000 tons of equipment and material, chiefly cement, and that the cost of transporting it by motor trucks from the nearest point of the existing Sierra railway would be $3,095,000, or that it could be transported by rail over a special road at a comparative cost of $2,010,000, thus effecting a saving in transportation of $1,085,000 which could be realized by the construction of a railroad having great additional value for expediting the work, developing the resources of the country and earning freight on commercial business.

As the transportation of cement by motor trucks at that time involved double sacking it, at a cost of 11c extra per sack, and there was danger that, notwithstanding this precaution, considerable loss might be sustained and controversies arise, it was decided to build the railroad at the earliest possible date and defer as much of the construction as possible until after it was completed and in service to deliver the necessary plant and materials.

The route was surveyed and the construction supervised by six engineering parties that of course provided the data for all line and grade work, the location of structures, and supervised the building of culverts, trestles and bridges. In June, 1915, the location survey was completed on the present line 67.63 miles long, extending eastwardly from Hetch Hetchy Junction on the Sierra railway to the Hetch Hetchy dam site over a very crooked course as it follows the contours of the hills and mountains through the rough country where previously only a trail existed.

UNLOADING RAILS AT RAIL HEAD OF SERVICE RAILROAD.

At the western end of the line the road drops 310 feet in 9 miles and crosses the Tuolumne River 12 feet above high water on a bridge having a 220-foot steel truss span and 40-foot deck plate girder approach spans.

The railroad being designed to serve also as a common freight carrier passes through all of the towns likely to provide business for it and winds through the rough country with many sharp curves having a maximum of 30 degrees and many of 18 to 26 degrees. The maximum grade is 4 per cent and the adoption of these limits and the great care used in location cut the cost of construction remarkably low.

The contract for the construction of the roads for $1,543,080.74 was awarded to S. Rolandi, San Francisco, was certified by the auditor Feb. 15, 1916 and the road was completed sufficiently to carry traffic in May, 1917, and put in immediate service. The difference of elevation between the highest and lowest parts of the road is 4,400 feet and the nine miles at the eastern end pass through extremely rough country where in many cases the road bed was terraced on the sides of almost vertical rock cliffs.

The road is of standard gage with 60-pound rails laid on rock ballast, and has a roadbed 16 feet wide at subgrade except for nine miles in the Hetch Hetchy valley, where it is increased to 22 feet. Embankment slopes are 1½ horizontal to 1 vertical. Grading required about 1,000,000 yards of excavation, more than half of it being granite, solid rock and soft rock.

Alternate bids were invited on classified and unclassified materials, and the contract was awarded on the latter basis at a rate of 67c per yard for all kinds of material. The road was constructed with an average force of 600 men. Tracklaying was done by hand, the rails being unloaded from the platform cars of the construction train by several pairs of men lifting them with rail tongs and advancing them over the end of the forward car on standing rollers.

The character of the grading required is illustrated by the accompanying view of a road leading to the south fork tunnel portals which although not a portion of the regular construction railroad indicates the character of the country through which the latter passes.

OPERATION.

The road is operated by the city, directed by the city engineer as general manager and the first assistant city engineer as assistant manager.

The rates charged for public transportations were intended to cover the interest at 4½ per cent on the construction cost and to provide an amortization fund. On this basis the charge was fixed at 7½c per mile for passengers and 12½c per ton mile for freight in carload lots.

The entire water system and the auxiliary and supplementary works were designed and their construction is being carried on under the direction of M. M. O'Shaughnessy, city engineer.

Asphalt Pavements in Buffalo

Buffalo is a severe city on asphalt pavements. The temperature ranges from 14 degrees below zero in winter to 95 degrees above zero in summer, according to the latest U. S. Weather Bureau report. Nevertheless, Buffalo has in existence today some of the oldest asphalt pavements in the United States. Bryant street, laid with Trinidad Lake Asphalt in 1881, thirty-nine years ago, is in perfect condition today, having cost only $0.03 per square yard per year to maintain.

The total yardage of all asphalt streets in Buffalo is 4,838,792 square yards.

The total yardage of Trinidad and Bermudez Lake Asphalts is 4,374,041, or 90.5 per cent of the total yardage.

Stream Gauging Methods and Uses

The Naugatuck River, in Connecticut, was gauged by methods adopted to special conditions, the run-off estimated from long-time records on a similar watershed, and on the basis of this was calculated the advantage of equalization by storage, from the point of view of both sanitation and water power.

Some months ago a survey was made of the principal streams in Connecticut, which was carried out along four lines of investigation. The first of these was a measurement of the flow of the stream in connection with a chemical and bacteriological examination of the water, for the purpose of ascertaining the extent of pollution under known conditions of flow. The second, a determination of the average flow for the purpose of estimating the developed water power of the mills and the quantity available for storage. Third, the effect upon the flow of the stream of storing water during the high-flow months and letting it down so as to equalize the flow during the low-flow months; the extent to which such equalized flow would improve the sanitary condition of the river and add to the present developed water power; and the estimated value of such additional water power. Fourth an investigation of reservoir sites to ascertain to what extent water could be impounded and the probable cost of such development.

The study of the flow of the Naugatuck river, together with the run-off of its drainage area, was made under the direction of Charles A. Ferry of New Haven.

For ascertaining the flow of the stream, five guaging stations were established, located at points where the river was fairly straight for a considerable distance both above and below the station, and where the banks were high and the cross-section of the river was fairly uniform and free from obstructions that would create eddies and cross currents. These stations were equipped with Sanborn automatic recording guages, which gave a continuous record, for seven days, of the height of the water above certain fixed points. Two of these recorders were designed to give readings for a difference of elevation of five feet, and the other three for differences of ten feet.

CROSS-SECTIONING THE RIVER.

As the water was too deep in places to admit of wading and as no boats were available, cross-sections of the channel were made by means of a sounding lead suspended from a wire stretched across the river and anchored to deadmen on the banks. This sounding lead was supported by a light chain made with half-inch links running through a pulley, which was made to slide along the wire by means of an endless cord passing through screw-eyes screwed into the deadman. Every sixth link was indicated by a different colored piece of cloth; and by noting, with the aid of a transit, the color of the first cloth above the water surface and counting the number of links between it and the surface, the depth of water at each point could be ascertained. The pulley referred to was moved from point to point on the cable and the sounding lead lowered at each point, and in this way an accurate profile of the bed of the river was obtained. The location of the pulley each time was determined by means of a 200-foot steel tape, the end of which was fastened to the pulley and the reading taken at the zero point on shore.

Velocities were obtained by means of a current meter lowered by the same apparatus, but in this case there was, in addition, the cable from the meter to the telephone receiver, by means of which the revolutions of the meter were counted. Current meter measurements were made for different stages of the river, and from these measurements rating curves were constructed for each station, and from these were computed the daily flows as indicated by the recording charts.

RAINFALL.

So far as known, no previous records of the rainfall from the Naugatuck water-shed had ever been made, and in the estimate of average seasonal and other stream-flow quantities, other watersheds in the vicinity where long-time records of this kind had been kept, were consulted. Those of the Croton shed appeared to be most nearly similar to the Naugatuck. The sheds are only a few miles apart, are of approximately of the same size, both lie in the path of the storms coming from the west, the topography of the two is very similar, although the sides of the Naugatuck valley are somewhat steeper than those of the Croton, and the conditions as to cultivation are about the same.

Accurate rainfall and runoff records have been kept on the Croton shed for fifty years, and rainfall records have been kept in the Naugatuck valley for thirty-one years. Comparing the records for this thirty-one-year period, we find the average rainfall in the Naugatuck valley to be 48.24 inches, and in the Croton valley 49.61 inches. Comparing the records by months, the similarity is still more striking. In three of the twelve months, the average difference for the thirty-one years was only .01 inch, and in seven of the twelve months was less than 0.1 inch. The maximum difference in any one month was in July 1897, when the rainfall on the Croton shed was 18.1 inches and on the Naugatuck, 12.49 inches.

Rainfall records have been kept on the Naugatuck shed by the Waterbury Water Department for sixteen years, and these show for the Naugatuck and Croton sheds respectively rainfalls of 46.32 and 47.64, runoff of 23.23 and 24.64, and percentage of runoff to rainfall of 50.2 and 50.9 respectively. Mr. Ferry concluded from the similarity between these records and conditions, that the Croton records for fifty years past can be employed with fair reliability in estimating the average flow of the Naugatuck river.

RUNOFF.

For the purpose of studying available power on the river, *ordinary* runoff flow was desired. For estimating ordinary flow, two rules were available, one by Desmond Fitzgerald and one by Professor Rankine. The former rule is to take the flow of the months above the average rate as being at the average rate, add to these the months below the average, excluding the lowest flow month, and divided by the whole year. Professor Rankine's rule is to arrange the discharges, observed daily, in order of magnitude without regard to date; divide this into an upper quarter, middle half and lower quarter; substitute the average of the middle half for the months of the upper quarter, and then take the mean of the whole list.

Using Fitzgerald's rule, modified to give ordinary *monthly* flow, it was found that the average flow was 21.10 cubic feet per second per square mile and the ordinary flow was 16.14; also that in September the average was practically double the ordinary, while in March it was only about 18 per cent greater, these being the extremes of variation.

The problem of the ordinary flow of this particular river is complicated by the presence of numerous storage reservoirs which tend to equalize the flow of the stream to a considerable extent. Six cities in the water-shed have public water supplies with storage reservoirs, the water from which eventually reaches the river through the city sewers.

To conserve the runoff from the 56.3 square miles of water-shed included in certain proposed developments so as to equalize the flow of the river during the eight low-flow months would require a storage capacity of 1,900 million cubic feet. Were this provided and the discharge regulated so as to equalize the flow, the average July flow at Waterbury would be increased from 110.3 to 280.9 cubic feet per second, and the average velocity from 0.63 to 1.1 feet per second.

SANITARY CONDITIONS.

Even the latter velocity would be insufficient to prevent the deposit of sludge in the river, and it is doubtful, therefore, whether the plan of establishing conservation reservoirs would have any marked effect in improving the sanitary condition of the river. If there should be any improvement it would be due to increased dilution rather than to scour or rapid removal of the sewage.

It was suggested that sanitary conditions might be benefitted by drawing off the water from the reservoirs for eight to twelve hours per day for the six working days instead of continuously. This method would temporarily increase the volume and velocity, but it is doubtful if this would be sufficient to prevent the depositing of sludge or to flush out the stream bed, while the intermittent flow would result in sludge being deposited on the banks of the stream and on sand bars with the daily resurrence of receding of the water. These deposits, exposed to the sun, would create a nuisance, which would probably offset any benefits from flushing.

Considered from the point of view of power, the equalization of flow presents an entirely different aspect. Most of the mills are provided with supplementary power, either steam or electricity or both, for use in time of deficient stream flow, and the value to them of the additional flow drawn from the reservoir would be simply that of the saving of coal or of electricity which would be effected. Assuming the value of one cent per horse power per hour, the total saving to the mills on the Naugatuck, as at present equipped, would be about $43,000 per year, if the 1,900 million cubic feet of storage were fully developed. This figure is based on a 24-hour run; with only eight or ten-hour runs per day, the saving would be much less. Some of the mills utilize only 0.32 cubic feet per second per square mile of tributary water-shed, while others use 3.82 cubic feet. Consequently the value to the mills of the proposed conservation plan would vary greatly—even more than is indicated by these figures, since the mills using the smallest amount would have sufficient water to run full time continuously except in periods of unusual drought.

Cost-Plus Contracts in Paving Streets

Among the questions making up the questionaire which we sent out a few weeks ago in collecting data concerning pavement construction, was one asking: "Did you employ cost-plucs contracts for any work? If so, what form of contract?" On account of the discussion which had appeared during 1919 in most of the periodicals which dealt with contracting in any way, it seemed to us probable that a number of cities had tried the cost-plus method, and that these and others would be interested in learning of experiences with it. We found, however, that only a very few cities had actually made use of this form. Such information as was given concerning its use is presented below.

Several cities stated that they had used it for paying for extra work done in connection with regular itemized-bid contracts. Aside from these, only seven cities reported using cost-plus contracts on paving work. Auburn, Maine, used cost plus 15 per cent; Fayetteville, North Carolina, for resurfacing old macadam, used cost plus 15 per cent; West Homestead, Pa., used cost plus 15 per cent for grading and paving; Providence, R. I., used cost plus 15 per cent; Columbia, S. C., cost plus 10 per cent; San Antonio, Tex., cost plus 10 per cent for grading.

Selma, Ala., used cost plus 15 per cent for sidewalks, and Ogdensburg, N. Y., used cost-plus form for curbing, the percentage not being stated. Fort Scott, Kansas, reported using this form (percentage not given) with strict supervision.

A few cities reported its use for work other than paving. For instance, Hibbing, Mont., uses cost plus 10 per cent for sewers; North Braddock, Pa., used a cost-plus contract for relaying sewers; Fairmont, W. Va., used it for bridges, and Houston, Tex., used it. From Ohio it was reported that it was against the state law for cities to employ the cost-plus form of contract.

Resurfacing Asphalt Pavements in New York

City forces remove about half an inch of the worn and deteriorated wearing surface without injuring the remainder, and replace it with new asphalt thoroughly welded on by 16-men gangs who averaged 1,450 square yards in 8 hours at a cost of less than $1.00 per yard for the 183,000 yards resurfaced in 1919.

In Manhattan Borough, New York City, 183,000 yards of worn asphalt pavement were resurfaced in 1919 at a cost of less than $183,000. The worthless material in the top of the old pavement was removed, without injuring the asphalt underneath, by the use of a hot air machine to soften it. The dead and injured old surface was removed down to unimpaired material and a thin layer of hot asphalt was perfectly welded to form a continuous new wearing surface that was applied as in original construction at a monthly rate of about 1,400 yards per day.

In Manhattan Borough nearly all of the streets, except in some of the most remote districts, have been paved for years; so long, in fact, that there is a large amount of pavement so much worn that it requires renewal or repairing that constitute the bulk of the paving work now executed there. Large quantities of sheet asphalt and block asphalt pavements are resurfaced every year, using the old base and generally part of the old top, but providing a new wearing surface. For several years this work has been accomplished by the heating method with which, during the year 1918, 151,000 square yards were surfaced and during 1919 183,000 square yards were surfaced at the cost of less than $1.00 per yard. This method is used on the streets having a concrete foundation covered with asphalt which is not yet worn out and which has not lost its life, but which has an irregular surface.

The essential features are the heating of the surface enough to soften it and permit the removal of about one-half inch of its thickness without injuring the good material beneath, and the application of the regular asphalt wearing surface laid smoothly and accurately, without visible joints, and thoroughly welded to the old asphalt.

HEATING AND REMOVING SURFACE ASPHALT.

The work here described does not include the ordinary patching or resurfacing of small areas of the surface enclosed by good pavement on all sides, but applies to the construction of an entire new surface usually in lengths of one or more city blocks, which is executed while traffic is excluded from that part of the street. The work is all done by city force account under direction of the Department of Public Works, C. M. Pinckney, chief engineer, W. E. Dey, division engineer. The quality of materials, workmanship, and paving operations conform to the specifications for regular asphalt pavement made with a binder course and an asphalt wearing surface having a thickness of 1½ inches when compressed. The asphaltic cement is mixed at the heating plant under the direct supervision of the engineers.

The first operation is the heating of the surface, which is done with a Lutz machine that eliminates the contact with the asphalt surface of a direct flame that cannot be accurately controlled and is likely to injure the good portion of asphalt.

The locomotive machines are provided with a steam boiler, an air chamber and a blowing apparatus that forces the large volume of air at a high temperature and at a uniform, moderate pressure adapted to secure best results through the blast pipe at the forward end of the machine, which terminates with an adjustable pyramidal hood having a 6 x 4-foot horizontal bottom opening. In service this opening is kept close to the pavement with just sufficient clearance to allow for the escape of the hot air. It is kept in one position long enough to soften the old asphalt to a depth of ½ inch to ¾ inch, an operation which usually takes from one to two minutes, after which the hood is elevated a few inches by the power attachment and is moved to an adjacent section of the pavement which is heated, and so on.

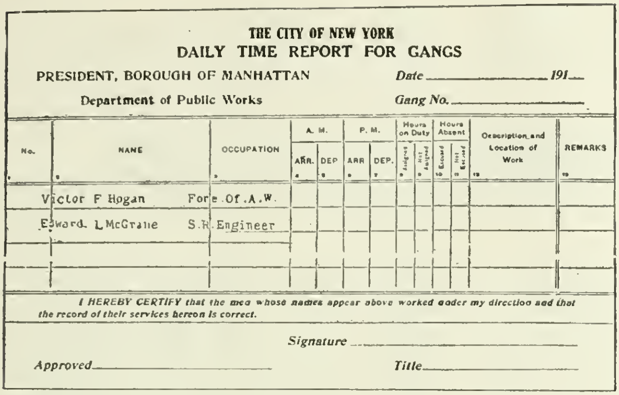
It is advantageous to use two heaters together, thus enabling the work to be prosecuted continuously, care being taken to coordinate the heating and removal of the damaged asphalt to correspond with the delivery of the new asphalt, so that the full sequence of operations is uninterrupted, and a continuous monolithic surface without joints is secured.

REMOVING OLD ASPHALT.

As soon as the hood is moved off from one position over softened asphalt, the latter is removed by rakers using heavy hoes made entirely of steel, with a 6 x 8 x ¼-inch blade having teeth about 1½ inches wide. All of the worn or injured material is raked off, to a depth of usually one-half inch to three-quarters inch, leaving a smooth, regular surface of live asphalt at a temperature of about 200 degrees. The asphalt that is removed is raked into piles that are immediately hauled away by two or more trucks or, if necessary, temporarily stored on the sidewalk. If any depressions below the general surface exist, they are filled with asphalt or sometimes with binder and the surface leveled and smoothed to receive the sheet asphalt.

APPLYING NEW SURFACE.

The wearing surface is of the standard type, composed of asphaltic cement and sharp sand



THE CITY OF NEW YORK
DAILY TIME REPORT FOR GANGS
PRESIDENT, BOROUGH OF MANHATTAN Date ____________ 191__
Department of Public Works Gang No. ____________

No.	NAME	OCCUPATION	A. M.		P. M.		Hours on Duty		Hours Absent		Description and Location of Work	REMARKS
			ARR.	DEP	ARR	DEP.	Assigned	Not Assigned	Excused	Not Excused		
	Victor F Hogan	Fore Of A.W.										
	Edward L McGrane	S.R. Engineer										

I HEREBY CERTIFY that the men whose names appear above worked under my direction and that the record of their services hereon is correct.

Signature ____________

Approved ____________ Title ____________

delivered from the city yards where they are mixed. The sand, limestone dust, and asphaltic cement are heated separately to a temperature of approximately 325 degrees Fahrenheit and are carefully proportioned by weight, thoroughly mixed, delivered from the yard to the street in a suitable covered truck, and are spread on the warm surface of the thoroughly raked old pavement, raked to the proper surface, rammed adjacent to track rails and boxes, and finished with a steam roller.

Particular care is taken to insure delivery of the hot asphalt quickly and regularly so that no visible joints will occur between successive batches. The work is done with such care and skill that excellent results and a very satisfactory surface are obtained, not only with the sheet asphalt pavement, but with the block asphalt pavement, which is much more difficult on account of the larger proportion of aggregate which it contains.

EQUIPMENT AND WORKING FORCE.

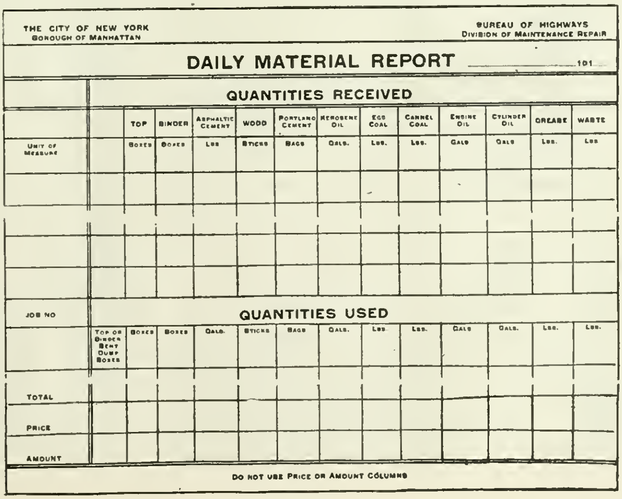
The equipment consists of the usual asphaltic tools and apparatus, including fire wagons for heating of tampers, shovels for hot stuff, tampers and smoothers, rakes, hoes, asphalt picks and axes, and eight to twelve-ton steam rollers for compressing the hot asphalt with a load of 200 pounds per square inch. The amount of rolling varies, about 1,500 yards per day being considered satisfactory for one machine. Cannel coal is burned in the grate of the fire wagon because it makes less smoke and soot, and is found to be no more costly than soft coal. During the first half of the year 1919, the regular asphalt gang consisted of one foreman at $6 per day, one roller man at $6, two rakers at $4.50, two tampers at $4.25, four shovelers at $3.50, three asphalt laborers at $3.25, one two-horse team and driver at $8.50 (working part time) and one operator at $6.

The average day's work varied from about 1,400 to 1,500 square yards. During August, 1919, one gang laid 36,200 square yards in 26 working days. The season commenced in May and ended in November. For a resurfacing from 1¼ to 1½ inches thick, about 1 1-10 cubic feet of material per square yard is required, and the cost of 94 cents includes labor on streets, 19 cents, fuel 3 cents, rent of heater (use of machine only without operator, fuel and supplies) 5 cents, materials delivered 64 cents, supplies and overhead 3 cents. The rate for 1919 was about the same, but for the latter half of 1919 it was increased, probably about 2 cents per square yard. In the material cost are included all materials charges, plant depreciation, repairs, fuel, labor, hauling and interest.

YARDS AND EQUIPMENT.

The principal city yard, on the East River at Avenue A, 90th and 91st Streets, occupies an area of abou 200 x 600 feet. with accommodations for the asphalt plant and garages for all the trucks and automobiles of the Department of Public Works. There are repair shops for all the machinery and other plant, storage sheds for rollers, wagons and trailers, and storage piles for sand and gravel which are recived on barges that are unloaded by clamshell buckets operated by derricks.

The asphalt is delivered in bulk from lighters, where it is kept hot so that it can be pumped into five elevated steel tanks of 20,000 to 40,000 gallon capacity, where it is kept liquid by steam coils. There are corresponding mixing machines and delivery wagons for preparing and distributing the binder and the surface asphalt, giving the plant a capacity for 3,000 yards of completed asphalt pavement with top and binder, which, plus the 1,000 yards output for ten repair gangs, makes a



THE CITY OF NEW YORK
BOROUGH OF MANHATTAN

BUREAU OF HIGHWAYS
DIVISION OF MAINTENANCE REPAIR

DAILY MATERIAL REPORT ____________ 191__

	QUANTITIES RECEIVED												
		TOP	BINDER	ASPHALTIC CEMENT	WOOD	PORTLAND CEMENT	KEROSENE OIL	EGG COAL	CANNEL COAL	ENGINE OIL	CYLINDER OIL	GREASE	WASTE
UNIT OF MEASURE		BOXES	BOXES	LBS	STICKS	BAGS	GALS.	LBS.	LBS.	GALS	GALS	LBS.	LBS
JOB NO	QUANTITIES USED												
	TOP OR BINDER SENT DUMP BOXES	BOXES	BOXES	GALS.	STICKS	BAGS	GALS.	LBS.	LBS.	GALS	GALS.	LBS.	LBS.
TOTAL													
PRICE													
AMOUNT													

DO NOT USE PRICE OR AMOUNT COLUMNS

total capacity of about 4,000 yards per day. Besides this plant, there are several smaller plants located at different parts of the borough where materials and equipment are stored for small repair and patch work.

The resurfacing is done by two regular gangs of twelve to fourteen men each, including about two rakers, two tampers, two cutters, one top shoveler, one smoother, three asphalt workers, one foreman, one roller engine man, besides which a two-horse team is occupied part of the time in hauling away waste.

The asphalt yard is under the direct control of the chemical laboratory which continually watches the quality and proportions of materials that are frequently sampled and tested and are constantly inspected by an assistant always maintained at any contractor's plant, where work for the city is being done. The specifications here require a finer sand than is used in most cities, thus obtaining a denser and more durable mixture.

RECORDS AND REPORTS.

As all of the new asphalt work is done by contract with guarantee, very accurate records are kept of the condition of the surface, of the wear and tear of which detail reports are filed on inspection form No. 2, herewith reproduced.

For each job of resurfacing work, a serial order number is given to the foreman in charge, who hands in daily reports of labor and material on blank forms giving all the data that, when posted up, shows the classified cost.

TYPICAL JOBS EXECUTED.

One of the largest jobs during the year was the laying of 92,800 square yards of new surface in Seventh Avenue between 100th and 153rd Streets, to repair asphalt block pavement laid in 1908 and guaranteed until 1913. In 1915, the percentage of repairs was 6 per cent; in 1916, 17 per cent; in 1917, 3 per cent. By 1919 the surface had become very irregular and humpy, making travel decidely uncomfortable. The blocks were found not to be generally worn through any more than to correspond with the percentage of repairs, but the whole street was full of humps and hollows. The traffic was light and largely consisted of automobiles with soft tires, estimated to amount to between 50 and 75 tons per foot of width of pavement per 10-hour day. This is considered a fair example of the asphalt block pavement work done in 1918.

Another important job was resurfacing Fourth Avenue from Twenty-third to Thirty-second Street, where 11,000 square yards which were paved in 1910 with a guarantee that expired in 1916. In 1915, there were made 8 per cent. of repairs; in 1917, 22 per cent., and in 1918, 27 per cent. The traffic was very heavy, with a large proportion of steel tires, and amounted to between 100 and 115 tons per foot of width, per 10-hour day.

WEAR AND TEAR REPORTS.

Detail records of the physical condition of the pavement are prepared from the inspector's daily slips made out on forms printed on 4⅝ x 6 inch sheets, and ruled with eleven vertical columns and thirty horizontal record lines besides the headings, and the totals at the top and bottom of the page. The first vertical column is headed ITEM NUMBERS, which are printed from 1 to 30, one on each horizontal line. The second column is headed DISTANCE ALONG CURB; third, CURB; fourth, DISTANCE FROM CURB; fifth to eighth, DIMENSIONS; the fifth and sixth being LENGTH; and the seventh and eighth, BREADTH; the ninth and tenth are headed AREA; and the eleventh column, which is rather wide, is printed on lines parallel to the vertical ruling with spaces titled respectively, STREET OR AVENUE, FROM, TO, STREETS OUT OF GUARANTEE, and KIND OF PAVEMENT. This column also contains the titles, CITY OF NEW YORK, BOROUGH OF MANHATTAN, DEPARTMENT OF PUBLIC WORKS, BUREAU OF ENGINEERING, INSPECTION FORM NO. 2, and the caption, WEAR AND TEAR REPORTS, ORDER NO. At the foot of the page there are lines for TOTAL SQUARE FEET and TOTAL SQUARE YARDS, and underneath them, "I hereby certify that the pavement at the........locations stated herein has been repaired in accordance with the specifications and that the measurements as shown are correct.

............191 ....

Inspector."

The work is in charge of C. M. Pinckney, chief engineer, Bureau of Engineering, Department of Public Works.

Unusually Safe and Attractive Road Contracts Unappreciated

An official communication from Madison, Wisconsin, announces a remarkable indifference on the part of local contractors to the efforts of the state officials to promote active road constructions by safeguarding the contractor and giving him unusually valuable estimating data.

Due to the fact that the Wisconsin Highway Commission has been allotted a certain amount of cement for use during the construction season of 1920, the Wisconsin Highway Commission has issued its circular letter No. 2, to Contractors and Material Companies and Machinery Companies, outlining certain road projects which will be given preference in the line of construction over any others and which will be advertised for bids from time to time.

On many of the jobs listed the plans are already completed and lettings have been, or are being held. To date about one-half of the work advertised has been let. In most cases the estimated quantities and length of projects are given and information is noted concerning physical or geological data, available materials or working conditions that are of unusual value to the contractor for making intelligent bids. Notwithstanding these advantages there has been a great scarcity of contractors bidding, apparently the contractors fearing the market conditions, and further, wanting to wait and see what prices the State would be willing to pay.

With the cement prices guaranteed and protected, and with the state paying for materials on the road, as the commission's new specifications call for, the commission fails to see where the contractor is making a very big gamble on the present conditions.

Skin Friction and Beaming of Piles*

Extended practical experience indicates that popular values for skin friction on piles are often too high; that horizontal earth pressures are usually much less than sometimes assumed, and that the center cores in hollow piles offer great resistance to pile sinking.

In the matter of the bearing value of soil at the base of deep foundations, especially caissons and piling, there seems to be considerable difference of opinion among engineers as to the relative value of bearing area and skin-friction. It has been customary for engineers to assume that soil at the foot of a pile is capable of sustaining only from 4 to 6 tons and crediting the remaining value of the resistence to skin friction. This resultant value for frictional resistance has, in numerous cases, been apparently checked by engineers in noting the resistance offered in pulling piles.

From observations of this character it has been common practice to give skin frictional resistance as high a value as from 1,000 to 2,000 pounds per square foot, and the writer is aware of instances in which it has been placed higher. The writer believes that it is not safe at any time to give a value to frictional resistance, unaided by taper or irregularities (projections, knots, etc.) higher than 50 pounds. His reasons for making this somewhat drastic assertion in the face of the foregoing statement are partially summed up in what immediately follows, and for which the writer must apologize for its somewhat elementary tone.

HORIZONTAL PRESSURES INVESTIGATED.

If a billet of wood, or plate of steel, be laid on an open box containing molding sand and the box be inclined until the plate or billet slides, the angle or coefficient of friction is at once determined. Assuming for the moment that this coefficient is found to be 40 per cent. of the weight or pressure; then, no matter how great or how small the loading thereafter, the superimposed material can always be moved horizontally by exerting a horizontal pressure equal to 40 per cent. of the weight of the material.

It follows necessarily that the frictional resistance of a smooth-bore pile sunk into material between which and the pile surface the coefficient of friction is 40 per cent., will have to resist a pressure of 5,000 pounds per square foot in order to develop a pressure of 2,000 pounds skin-friction. Considering the fact that a smooth-bore pile of ordinary dimensions (as one foot diam. or under) may frequently be withdrawn from the ground leaving the hole intact, the absurdity of crediting any such pressures to the superficial area of small piles is evident. It should be noted, however, that, as in tunnels, the larger the diameter the greater the pressure per square foot (in homogeneous soil), so in piles or caissons the greater the diameter the greater the pressure per square foot. It is thus possible to design a caisson whose superficial area will be so great as to prevent its sinking due to the tremendous frictional resistance per square foot; while a number of small caissons of a total equivalent bearing area but much larger superficial area in the aggregate would meet with comparatively small frictional resistance per square foot if sunk plumb. In this connection resistance due to insufficient clearing of the cutting edges; binding due to the caisson being out of plumb, etc., should not be confused with skin frictional resistance.

BEARING AREA.

A clearly defined line of demarkation should also be drawn between what is actually bearing and what is frictional area. The writer believes that this can be simplified by stating that bearing area constitutes the equivalent bottom area as well as all horizontally projected areas of taper and other large projections such as collars, bands, knots, etc.; while the frictional area consists of all vertical or approximately vertical areas—that is, horizontal area is bearing area and vertical area is frictional area.

It is readily seen that if the theory of the lateral transmission of pressure is sufficiently set up, that the bearing value due to the taper of a pile is a very considerable factor. If, for instance, we take a pile of 6-in. diam. at point and 12-in. diam. of butt (at effective depth) the bearing for the point is practically 0.2 feet, while the area of the taper is 0.585 feet.

The error due to computing the frictional resistance of a pile by the pull required to withdraw it, is frequently caused by the impracticability of pulling a pile without causing considerable binding due to the line of the pull not being in line of the piles axis.

As to his reasons for stating that frictional resistance has been rated too high, the writer cites the following notes:

CORE RESISTANCE.

(Note A) In the matter of sinking, under his direct supervision, several hundred steel cylinder piles 12 to 14 inches diam. and of practically smooth bore, he has always found that a pile driven to refusal by hammer or jack could be made to sink with comparatively light pressure as soon as the core of earth or obstruction down to the cutting edge was removed. Ordinarily it might be thought that the accumulation of a core of earth in a hollow pile could not materially effect its progress.

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*Excerpt from paper presented to Brooklyn Engineers' Club on Deep Foundation and Piling.

It has been found, however, that in nearly all instances where this core has accumulated to a depth of 3 or 4 feet it compacts itself in the pile footing, being held in place by the lateral pressure against the sides, assisted somewhat by the nearest inside collar and because of the relative increase of friction with pressure it becomes as incapable of being dislodged by the downward pressure of the pile as though composed of concrete. 12 and 14-in. piles have frequently been noted under these conditions as resisting pressure from 60 to 90 tons and carrying down a core 2 or 3 feet deep and which when the core was removed sand redaily under the 6-inch drop of a 350 pound hammer.

(Note B) In the matter of sinking deep well casings it would be virtually impossible to do this if frictional resistance values ran as high as from 1,000 to 2,000 pounds. For instance, an 8-inch casing sunk 1,000 feet would develop at 2,000 lb. per square foot something like 2,000 tons resistance; whereas the maximum strength of the pipe, if extra heavy, would not be over 1,000 tons.

(Note C) In some of the early experimental work on Long Island the Board of Water Supply sunk a 12-inch smooth bore hollow steel pile more than 800 feet, using jacks whose maximum rating was 100 tons. It is stated that no special difficulty was met in sinking this pipe when it was fully cleaned out.

While it is not probable that the full force of the jacks was used or required, assuming that such was the case the maximum frictional resistance per square foot did not exceed 75 pounds.

TORSIONAL MEASURE OF FRICTION.

(Note D) It is frequently noted in sinking test borings that tubes or casing which can not be pulled without breaking (due probably to the binding, and to collar or couplings) can readily be turned with chain tongs by hand.

(Note E) It would appear then that a simple effective test of frictional resistance can be made by placing a cylinder in a box or bed of normally dry sand. The cylinder should have an axle throughout its length to insure equal stress in turning, and, if practicable, this axle should project beyond each end of the box or bed. By establishing the coefficient of friction and determining the resistance to turning, the frictional resistance may be found, as well as the pressure of the sand, on the pipe.

Bolshevik Strike Threats

The anthracite coal miners are announced to be preparing with incredible effrontery to demand on Mar. 9 an increase of 60 per cent in wages, a 6-hour day and 5-day week for an organization of about 170,000 men. The bituminous coal miners, following their conspicuously, reckless and unreasonable denunciation of the 14 per cent increase to their already high wages just granted them, are due to make further trouble about the 1st of April. The attitude of the railroad brotherhoods in their threatening demands for larger and larger increases of wages, their insolent attempts to coerce the government, and their threats to defeat Congressmen and Senators who dare to vote against their selfish and unwholesome propositions, together with the latest bluff of a shopmen's strike in hopes to hold up the railroad owners by embarrassing them with government action before the return of the property, all show clearly enough their determination to make their demands as confiscatory as the traffic will bear, and then some.

The whole system of forcing up wages to absurd and impossible levels simply because organized labor has political and industrial power and is disposed to use it ruthlessly, is the worst possible national policy, and if permitted to continue long enough can only end in self defeat. There is and can be no objection to the highest kind of wages provided they are *earned,* and most employers greatly prefer men who are worth a high price to those who are worth only a low price. The trouble lies in the fact that the high wages are rarely earned, and that the higher they grow, the more time and money the laborers have for various indulgencies, the more disinclined they are to work, the less able they are to work well, the less inclined to render an honest equivalent for their pay, and the greater the labor turnover.

Efficiency has decreased enormously, being conservatively estimated at only 30 to 60 per cent of what it generally was five years ago in this country. The tendency to greatly shorten the working days makes it very difficult to secure enough products to pay the fixed and overhead charges that must be met before any profits can be accrued or funds be provided for extensions and improvements. The 6-hour day and the 5-day week are utterly inadequate and absurd and an insult to civilization itself which cannot at this stage maintain decency and comfort, to say nothing of progress or safety, without a very much higher amount of efficient service from skilled and unskilled labor.

Record Road Construction in Pennsylvania

During 1919 the Pennsylvania State Highway Department of Pennsylvania completed the construction of 253.10 miles of durable highway and 41.58 miles of uncovered base, notwithstanding that the unusually rainy weather greatly interfered with the work of contractors during all of 1919. There was an average of 127 days of rain during the year in Pennsylvania. This meant that not only was the work of the contractor interfered with on the day of rain, but on subsequent days until the subgrade dried sufficiently to permit operations to resume. Reports received by the Department show that this mileage was not equaled by any other commonwealth.

During 1919 the State Highway Department contracted for the construction of 685.02 miles of durable roadway of various types. Contracts carried over from 1918 into 1919 totaled 95.47 miles. During 1919, 73.36 miles of the uncompleted 1918 mileage was finished and there remains to be done 22.11 miles. Of the 685.02 miles contracted for in 1919, 179.74 miles were entirely completed when contractors were compelled to shut down for the winter. A total of 3,316,306 feet of roadway is involved in contracts awarded during 1919.

Many miles of new roadway will be completed very early in the coming season.

NEWS OF THE SOCIETIES

March 8-9—INDIANA SANITARY AND WATER SUPPLY ASSOCIATION. Annual Convention at French Lick, Ind. Secretary-Treasurer, L. R. Taylor, French Lick, Ind.

March 8-10. INDIANA SOCIETY OF SANITARY ENGINEERS, Richmond, Ind. Secretary, Indianapolis, Ind.

March 10.—VERMONT SOCIETY OF ENGINEERS. Meeting and convention at Burlington, Vt., Secretary, George A. Reed, Montpelier, Vt.

March 10. THE NEW ENGLAND WATER WORKS ASSOCIATION. Meeting at Hotel Brunswick, Boston. Secretary, Frank J. Gifford, Dedham, Mass.

March 16-18. — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Manhattan Building, Chicago.

March 24-25. NATIONAL WHOLESALE LUMBER DEALERS ASSOCIATION, Washington, D. C. Secretary, 66 Broadway, New York.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

March 24-26. SOCIETY OF INDUSTRIAL ENGINEERS, Bellevue-Stratford Hotel, Philadelphia. Secretary, 327 South La Salle St., Chicago.

March 25. NORTH CAROLINA PINE ASSOCIATION, Norfolk, Va. Secretary, Norfolk, Va.

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

National Federation of Construction Industries.

The Advisory Board of one hundred and fifty-three members representing all sections of the United States and all lines of construction and related business is favorable to the principle of the creation of a National Department of Public Works, but the following features of the bill are objected to:

The transfer of the Bureau of Education, Bureau of Indian Affairs and Howard University to the Department of Labor.

The transfer of the Forest Service from the Department of Agriculture to the Department of Public Works.

The fact that Assistant Secretaries of the Department of Public Works are not necessarily to be selected by the Secretary of Public Works.

The elimination of the Department of Labor.

At the convention of the National Department of Public Works Association, on Jan. 13 and 14, 1920, at Washington, the following resolutions, which have some bearing on the above objections, were adopted:

Section 3 of H. R. 6649-S, 232 (the Jones-Reavis bill) has nothing to do with public works. The only reason for its presence in the bill is that some departmental disposition must be made of the non-engineering bureaus in the Interior Department.

It is manifest that the numerous organizations which have become affiliated under the name of National Public Works Department Association for a common public works purpose do not, by so doing, commit themselves with respect to any other question, national or otherwise. Therefore, each affiliated organization may have and is entitled to express its views as to said Section 3 of the bill without in any way qualifying its approval of the remainder of the bill.

The National Public Works Department Association, as such, is therefore unable either to approve or to disapprove the specific assignments of bureaus in the said Section 3, and in advocating the bill before committees of Congress the agents of this association are to be instrusted to present this fact in an unmistakable way.

The National Public Works Department Association suggests to all affiliated organizations that they present to Congress thsir own individual views with respect to said Section 3, either through its legislative agents of this association or otherwise.

The first annual meeting of the Federation will be held at the Hotel Sherman, Chicago, Ill., March 24-25. Experience has disclosed the desirability of a number of changes in methods of working. The directors have presented amended by-laws, which are proposed for adoption at the annual meeting.

More than a year has ensued since the by-laws were adopted. Among the important amendments which are indicated to be desirable are a more exact definition of the purposes of the Federation, a revision of association membership dues, the admission to suffrage of individual members, an increase in the number of directors and revision of the method of their selection, an increase in the number of vice-presidents, the creation of the advisory board, provision for the staff council, and the development of district organizations.

Member Associations are requested to confer upon their delegates to the annual meeting power to act in the adoption of amendments to the by-laws, and to submit to the board of directors, through the secretary, not later than March 15, 1920, any desired amendments to the proposed by-laws.

Associations which are not members of the Federation are requested to send representatives to the annual meeting with power to make application for membership in the name of their association, and to furnish credentials conferring upon their representatives the power of delegates as soon as their association shall have been elected to membership.

Individual members are requested to submit to the board of directors of the Federation, through the secretary, not later than March 15, 1920, any desired amendments to the proposed by-laws.

JOHN C. FRAZEE,
Executive Secretary.

Texas Highway Building Association.

An organization of highway builders and others interested in the construction of good roads was effected at a convention of highway experts at Austin, Texas, which adjourned Feb. 21. Its purpose is the promotion of building of highways and to coordinate the various interests and agents that are directley interested in the building and promotion of highways.

The following officers were elected:

R. G. Tyler, professor of highway engineering, University of Texas, president; R. V. Glenn, of Fort Worth, Newman A. Gregory, of Texarkana, L. W. Kemp, of Houston, and County Judge E. M. Overshiner, of Taylor County, vice-presidents. The board of directors consists of the president of the association, the State Highway Engineer and Federal Engineer as ex-officio members, and J. C. Nagle, professor of engineering of A. & M. College; Judge Cecil Simpson, of Dallas, Ed Dennis, of San Antonio, and R. J. Potts, of Waco.

American Society Civil Engineers.

At the regular meeting, March 3, a paper on "The Light Railways of the Battlefront in France" wae presented by Frank G. Jouch.

Am. Soc. C. E. Seattle Branch.

The Seattle Chapter of the American Society of Civil Engineers held their anual meeting Feb. 9, electing the folowing officers:

J. L. Hall, president; Maj. Carl Reeves, vice-president; Capt. B. D. Dean, secretary-treasurer. The evening was featured with talks by Col. J. A. Woodruff, corps of engineers, who described the work of the division of construction and forestry of the army in France, and Prof. C. C. Moore, of the University of Washington, who spoke on the engineers' camp at Camp Humphreys. A. H. Dimock, city engineer, discussed the Skagit River development work to be undertaken by the city.

Western Massachusetts Engineers.

At a meeting in Springfield Feb. 24 a paper on Street Lighting, illustrated by stereoptican slides was presented by W. E. Hodge, deputy in charge of Springfield lighting. An address, illustrated by moving picture films and slides, was given by John L. Hopper, vice-president and chief engineer of the Niagara Falls Power Company. The plans which this company operates and the original plant above the falls and the hydraluic power company plant on the American side and the Ontario plant on the Canadian side. The combined output of these plants, including three new 40,000 horse power units, produce the world's largest power output.

The New England Waterworks Association.

The March meeting of the New England Waterworks Association will be held at Hotel Brunswick, Copley Square, Boston, Wednesday, March, 10. Lunch will be served at the hotel. Tickets, $1.50. Papers will be presented on "Progress in Making an Established Waterworks Modern and Efficient," by Reeves J. Newsom, Commissioner of Water Supply, Lynn, Mass., and on "Atlantic City High Pressure Fire System," by Lincoln Van Gilder, engineer and superintendent Water Department, Atlantic City, N. J. The discussion on "The Efficiency of Pipe-Jointing Compound as Compared With Lead" will be opened by Fred O. Stevens, superintendent of Waterworks, Weymouth, Mass.

The rooms of the association, 715 Tremont Temple, are open for the use of members daily from 9 a. m. to 5 p. m.

PERSONALS

Dermott, W. J., has been appointed city engineer of Radford, Va.

Massie, Walter W., has been appointed city engineer of Cranston, R. I.

Head, Orrin W., has been appointed superintendent of streets of Concord, N. H.

Rice, C. E., has resigned as engineer of the City Planning Commission of Akron, O.

Phillips, F. E., has resigned as bridge engineer of the Montana State Highway Commission.

Kaltenbach, Charles J., has resigned as bridge engineer of the West Virginia State Highway Commission.

Marble, Arthur C., has resigned as city engineer of Lawrence, Mass.

Priestman, Robert W., has been appointed city engineer of Lawrence, Mass.

Morton, R. M., has been appointed engineer of the Highway Commission of San Diego County, Cal.

Evans, Kenneth, has been promoted from assistant construction engineer, Division of Highways, Illinois Department of Public Works and Buildings.

Davis, E. H., has been appointed chief engineer of the sixth district, Georgia Highway Department.

Marble, Arthur I., has resigned as city engineer of Lawrence, Mass.

INDUSTRIAL NEWS

Research in Alloys.

In an effort to obtain and present in concrete form information and data which will be of value to numerous industries of the country, the National Research Council, through the Division of Industrial Research, is organizing a co-operative association to carry on fundamental research in alloys. Scattered investigators have done much valuable work in this field, but a co-operative association composed of specialists representing both the manufacturers and the more extensive users of alloys can obtain and classify additional results of great importance.

It is, therefore, proposed to create a special scientific staff with a director and assistant director of research and a group of scientific investigators and technical experts who will devote their whole time to this work. Each member of the co-operative association will pay $1,000 to finance the organization, and all contributing members who may be either alloy manufacturers, using individuals, firms, or companies are to benefit alike by the results of the researches carried on by the association.

F. C. Austin Company Increases Manufacturing Facilities.

The combination of the Austin and Linderman plants increases eight-fold the capacity of the present Austin output, which gives this new company the largest capacity for earth-loading and cement-working machinery in the United States.

The F. C. Austin Machinery Co. is incorporated to take over the entire business of the F. C. Austin Company, Inc., the Municipal Engineering & Contracting Company and the Muskegon plants of the Linderman Steel & Machine Co., and retains the personnel of the companies whose combined efforts are directed towards supplying the demand for the Austin machines.

F. C. Austin retires from the active management, and the president of the Linderman Company, Mr. B. A. Linderman, assumes control.

Offices of the combination will continue in the Railway Exchange Building, Chicago.

Hendricks' Commercial Register.

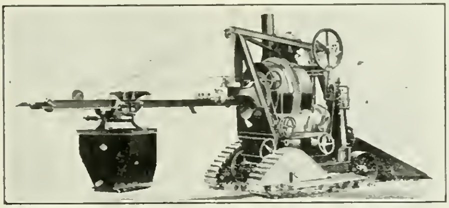
The 28th annual edition of "Hendricks' Commercial Register of the United States for Buyers and Sellers" for 1920 contains several improvements. The most noticeable being the new method of exterior indexing by coloring the front edge red, white and blue to indicate the different sections of the book. The Trades Index is a section of 162 pages in which every product listed in the book is indexed and cross indexed for ready reference. The main classified trades list contains 1,813 pages, listing over 18,000 different products. The present edition has over 1,200 new headings, including many headings completely covering the chemical industry. The third section of the book contains 216 pages listing the trade names under which products are manufactured, with the name and address of the manufacturer. The alphabetical section of 487 pages contains all the names in the book in one alphabetical list with addresses, and their main line of business. This is followed by the index to advertisers of 20 pages, containing a full list of branch and foreign offices following each name. The whole book is a volume of 2,703 pages. The list of trade headings covers from the raw material to the finished article all products connected with the Electrical, Engineering, Hardware, Iron, Mechanical, Mill, Mining, Quarrying, Chemical, Railroad, Steel, Architectural, Contracting and kindred industries, and the firms listed cover Producers, Manufacturers, Dealers and Consumers.

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

Smith Simplex Paving Mixer.

In the Smith Simplex Paving Mixer, built by the T. L. Smith Company, there are only eleven gears used, although the paver is entirely gear driven with the exception of the chain running from the drive shaft to the wheels.



BOOM AND BUCKET PAVER WITH CATERPILLER TRACTION.

Steel castings have been used in many cases where the usual iron castings might have sufficed under ordinary conditions. The frame is made of tough steel channels which are heavily reinforced, and all of its strength requires surprisingly light weight.

The entire operation of the machine is controlled by four levers and four control wheels all located within the easy reach of a man standing on the operator's platform.

Another feature of paramount importance to the contractor found only in the Simplex Paver is the possibility of firing it with either a boom-and-bucket or a chute delivery. The frame is so constructed as to accommodate either equipment, and the change can be made quickly—right on the job if necessary. The traction may be the wheel or the caterpillar type.

Blaw-Knox Forms.

A small folder recently issued by the Blaw-Knox Co. illustrates the very wide range of concrete construction for which it provides special lines of concrete forms of standard type, most of them adjustable, that are either rented or sold, for almost all kinds of work.

Collapsible forms, the larger sizes being carried on travelers, are leased for the construction of tunnels, sewers, aqueducts, subways, culverts and similar work. For tunnel work there are also provided liner plates, flanged sections of rings that can be bolted together to take the place of timbering in soft ground.

Truss centers of structural steel are leased for erecting concrete bridge arches, and strong structural steel forms, provided if necessary with steel travelers for shifting and supporting them, are designed, fabricated and leased for the construction of dams, piers, abutments, retaining walls, reservoirs and other heavy work. Light wall forms are also available for grain elevators, coaling stations, reservoir walls, circular tanks and other purposes.

A separate booklet on Blaw forms describes the quick acting slip joint connection and illustrates the use of a standard form for all kinds of road and street work. Complete service in building construction is provided by the use of floor and roof slab forms and adjustable circular column forms which will be erected, shored and removed at a flat price.

Among the advantages of these forms are the rapidity and accuracy with which they can be set and removed, their reliability and freedom from warping, twisting and splitting. They are practically indestructible, and can be used repeatedly for years.

Saving Fuel Automatically and Scientifically in the Boiler Room.

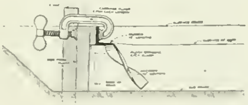
This is the title of a new 24-page booklet published by the Northern Equipment Co., Erie, Pa. It is based upon matter that was prepared for the United States Fuel Administration during the war. It thoroughly compares hand and mechanical feeding with mechanical regulation, as performed by the Copes Regulator. It shows in a convincing way what is to be desired in the way of scientific boiler feed regulation. Many charts and diagrams emphasize the value of scientific control.

Sterling Engines.

Sterling engines of the commercial type for pump and generator drives use gasoline fuel and are made with 4, 6 and 8 cylinders Four sizes of 60 to 148 h. p. are designed for operating standard underwriters fire pumps delivering from two to six 1⅛-inch hose streams, or from 500 to 1,500 gallons per minute. They have electric starters, generators and batteries insuring power to immediately meet any emergency. G R 6-cylinder, 225-h. p. motors at 1,500—1,600 R P M are built primarily for swift express cruisers and very fast runabouts and conform to marine engine standards. They have detachable cylinder heads and overhead dual inlets and dual exhaust valves. The light weight averaging between 8 and 9 pounds per h. p. is made possible by the extensive use of forgings. Sterling engines are made in sizes up to 300 h. p. and it is intended to increase them up to 450 h. p.

International Paving Guard.

This device. intended to protect the edges of macadam roads or other paving, consists essentially of a horizontal steel angle with the horizontal flange cut and bent so as to form twisted anchors extending into the concrete foundation and holding the guard firmly in place.



PAVING GUARD CLAMPED IN POSITION DURING ROAD CONSTRUCTION.

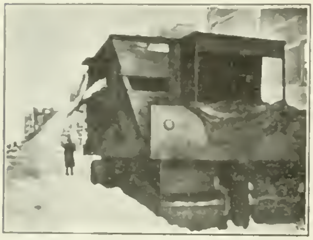
They are made from 2 x 2 x ¼-inch steel angles in 15-foot lengths with anchors formed 10 inches apart on centers. To install them, they are clamped or nailed to side forms or to stakes driven along the edge of the road, the upper edge of the angles being about ⅛ inch below surface grade.

Amco Segment Blocks.

Franklin G. Lynch, city engineer, Erie, Pa., reports favorable progress on the construction of an 8-foot circular sewer built under difficult conditions with Amco Segmental blocks.

Elevating Snow Excavator.

Among the devices used for removing the recent heavy icy snow fall from the streets of New York was a twenty-ton truck equipped with mechanism which enabled it to eat its way into a snowdrift, the snow being carried up into the truck body and then ejected down a chute to the gutter or to a smaller truck running alongside.



20-TON AUTOMOBILE EQUIPPED WITH SNOW EXCAVATING AND ELEVATING APPARATUS.

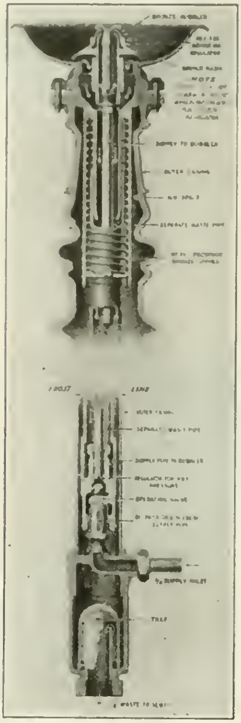
The National Snow Removing Company, owners of the truck, stated that the tests showed it capable of removing 9 cu. yds. of snow a minute, and able in a single day to do the work of 1,000 men. It is claimed to travel five miles an hour in from 3 to 4 feet of snow and will make a clearance of 11 feet wide, throwing the snow 20 feet clean of the truck. The machine is mounted on 40 x 12-inch United States solid tires, each made to carry a load of five tons.

New Iroquis Macadm Roller.

All parts of this machine are supported on a steel plate frame. The vertical boiler is a separate unit, to which no working parts are attached, which may be quickly and easily removed or repaired without disturbing the rest of the roller. The rear wheels are supplied with demountable rims which may be easily changed. The speed is governed by a differential gear like that of an automobile. It has a pilot steering gear, an adjustable steam scarifier, and belt-driven attachment for operating stone crushers and other plant.

Tiffin Motor Trucks.

These trucks, with worm gear drive, are made in 1½, 2½, 3½, 5 and 6-ton capacities and are equipped with four-cylinder motors, forced feed and splash system lubrication, centrifugal pump and fan cooling system, selective type transmission, Ross type steering gear and internal expanding service and emergency brakes. They are designed for use with 600, 750, 900, 1,000, 1,200, 1,400 and 1,500 gallon flushers.



VERTICAL SECTION THROUGH BUBBLE FOUNTAIN.

Murdock Patent Bubble Fountain.

This fountain intended for general use in streets, parks, outdoor places, mills, stations and many other public locations is simple, strong and durable and is recommended to school boards and mill owners. It drains automatically after each drink, is anti-freezing, anti-contagious and non-squirting.

The removal of three bolts enables the inner part to be lifted out from the strong outer casing that protects them. The self-closing feature saves water.

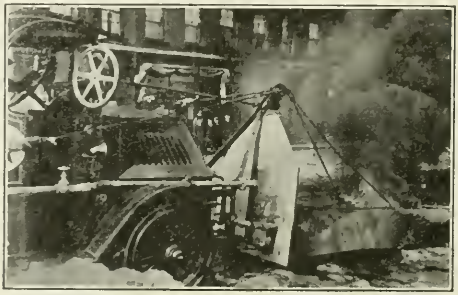
Safety Sanitary Rubbish Boxes.

These are made of heavy galvanized iron reinforced and are 20 inches square and 36 inches high, containing a burlap sack that, when filled, can be removed and replaced by an empty one in 10 seconds. They are made with four different tops, two of which are for use in streets and parks, permitting rubbish to be deposited in them from any angle and the other two operate somewhat like a mail box, and are used for factories and public buildings. In one city where 100 of these boxes are installed, the paper collected in them has been sold for more than $40 per week. They are manufactured by the Safety Sanitary Rubbish Box Co., who also make for city street cleaning department high grade steel pans 19 inches in diameter at the top, 15 inches at the bottom and 24 inches high, reinforced and provided with extra heavy handles.

Street Snow Melter.

One of the most novel of the devices offered for the removal of snow in city streets is the oil burning snow melter shown herewith mounted on a Mack seven and a half ton truck in use in Brooklyn, N. Y. It is the invention of L. V. Stevens, a Canadian engineer, and was first used successfully by the Canadian Pacific Railroad to clear its tracks.

The truck, which carries an 1,800 gallon tank of crude oil, travels at the rate of five miles per hour, belching an incandescent flame some ten feet ahead, collapsing snow banks as if by sun stroke. The oil and air are both forced ahead under compression through a mixer or carburetor, in a manner similar to the practices established in the case of blast furnaces and oil burning locomotives. Two pipes extend in front of the truck and crude oil from an 1,800-gallon tank on the truck is forced through the pipes while burning.



7½-TON TRUCK WITH FUEL TANK AND OIL BURNER MELTING SNOW IN BROOKLYN STREET.

Horse Maintenance In Pittsburgh

Average costs of keeping 446 horses in sixty-one municipal stables range from 18.5 cents per horse-day to 92.6 cents, averaging 68.5 cents. Figures are given showing the greater cost of keeping horses in active work than those of the Fire Department.

Through the courtesy of J. C. Slippy, chief accountant of the city of Pittsburgh, we have received some figures showing the cost of maintaining horses for the various municipal departments of that city. The figures are returned monthly and those given herein are a summary of these monthly reports for the six months ending June 30, 1919.

Sixty-one stables are included in the report and the total number of 81,538 horse-days is included in the statement—an average of 446 horses, or 7 1/3 per stable. Thirty-nine of the stables are in connection with fire engine houses, four are for police stations, six are for the Department of Highways and Sewers, three are for park service, and the others are miscellaneous.

The cost items are subdivided into "feed," "bedding," "shoeing," and others that are not itemized; each of these showing both the total cost and the cost per horse-day.

Under the head "feed," the cost per horse-day varies from a minimum of 16.6 cents at one of the fire engine stations, to a maximum of 78.5 cents at the filtration plant, there being three horses at the former and two horses at the latter. The greatest number of horse-days is found in one of the stables of the Division of Highways, which totals 8,393, and the cost of feed there was 70.6 cents per horse-day. The average cost per horse-day for all the stables was 56.2 cents.

Bedding costs varied from a minimum of 0.14 cent to a maximum of 9.2 cents; the average for all the stables being 3.2 cents.

The cost of shoeing varied from a minimum of 1.7 cents to a maximum of 12.9 cents. The average cost for all the stables was 9 cents .

The total cost of horse maintenance varied from a minimum of 18.5 cents to a maximum of 92.6 cents; the average for all the stables being 68.5 cents. This total includes other items not given in detail, but amounting altogether to 8.1 cents per horse-day.

HIGHER COST OF WORK HORSES.

All of the stables of the Division of Highways and Sewers and three of the Water Department show costs for feed much higher than any of the others, and the same stables with three others are considerable above the average in the cost of shoeing. The total costs were more than ten per cent higher than the average in the case of two of the park stables, all of those of the Division of Highways and Sewers and three of the Water Works stables. As this includes nearly all except those connected with the Fire and Police Departments, this higher cost would not necessarily tell against the departments named, for the reason that the engine horses receive comparatively little exercise except what is taken for their health; this also being indicated by the fact that the cost of shoeing these horses averages only about half as great as that of shoeing the horses of the Department of Highways and Sewers. It naturally and properly follows that the latter horses, which regularly do a strenuous day's work, receive more food and consequently run the cost of food higher than in the case of the Fire Department horses. This is indicated more exactly by the fact that the cost of feed for all of the engine horses averaged 43.4 cents per horse-day, while this item for the Department of Highways and Sewers averaged 66.8 cents, or 54 per cent greater.

The cost of bedding does not appear to bear any relation to the amount of service rendered, but probably is rather a function of the care and economy exercised by the several stable managers. As an illustration, among the fire engine companies alone there is a variation between a minimum of 0.7 cents per horse-day and a maximum of 7.4 cents per horse-day.

Paving Costs in Grafton

Grafton, W. Va., in 1916 laid Dunn wire-cut-lug brick on a four-inch base with 1½ inch sand cushion, using Carey's transverse expansion joints every 30 feet and longitudinal joints along each concrete curb. The contract price for this was $2.56 per square yard. At that time concrete cost $2.40 a barrel, sand $.75 a cubic yard, gravel, $.75 a cubic yard and labor $2 per day of eight hours.

No paving was done by the city between 1916 and 1919, but during the latter year the city laid 1,114 square yards of pavement similar in all respects to that laid in 1916, but the contract price was $3.54—practically $1 more than in 1916. Labor last year was receiving $3.60 for eight hours, cement was $2.97 a barrel and sand and gravel were $1 per cubic yard.

Taylor County, in which Grafton is located, is to vote on a $1,000,000 bond issue, and our informant, Findlay Barber, city engineer of Grafton, believes that it will carry, and about 2¾ miles of brick pavement with concrete base will be laid by the county within the city limits.

New Jersey Needs Adequate Highway Commission

Edward Edwards, Gov. of New Jersey, in his recent inaugural address, urged the legislator to abolish the present board of eight unsalaried highway commissioners and appoint a board of three adequately salaried men to be in constant session to direct the proper expenditure of nearly $10,000,000 a year that is the present program in this state. The interlocking business of counties and the relations of federal state and county appropriations should be promptly attended to, and it is believed that such a change in highway organization will be welcomed by existing boards now having concurrent powers.

Saratoga's Variable Lighting System

Current diverted at will from pairs of large to pairs of small lamps on same poles by short circuiting at power house.

Saratoga, N. Y., is to have a most distinctive and unique system of street and park illumination. This village of 15,000 population has peculiar conditions to meet. One month of the year it is the scene of a lively program of horse racing, three months it is an active summer resort and the other eight months it is just an ordinary village. As a result four months Saratoga has need for a brilliant lighting system but the other eight months merely an adequate and economical system is desired. W. D'A. Ryan, director of the General Electric Company illuminating engineering laboratory, was asked to survey the situation and make recommendations.

Mr. Ryan, who designed the elaborate lighting system for the Panama-Pacific Exposition, the Hudson-Fulton Centennial celebration, Niagara Falls and many of the principal cities of the country, recommended a system which will provide a Great White Way whenever it is wanted and an adequate and economical supply of lighting at other times. Saratoga immediately accepted the plan and installation will be started this spring.

One set of ornamental poles with but one circuit will be erected. On Broadway, Saratoga's principal street, a double globe fixture will be used. On the outskirts and in the parks the single globe will be used.

SPECIAL LAMP POST FOR TWO PAIRS OF LAMPS.

In each globe will be two Mazda lamps, one of 250 candle power and the other of 1,000 candle power. In the base of each pole will be a small relay box. By short circuiting the current at the power station, causing but a slight flicker in the illumination, these relay boxes will change the current from the big to the little lamp, or vice versa, as many times as occasion demands. So, during the summer season, the main street will be a Great White Way the early hours of the evening when the big lamps are used. At midnight, when need for these bright lights has passed, the current is short circuited and is shifted to the small lamps, adequate for all requirements from this hour until morning. And by the same arrangement the small lights may be used the entire night during the quiet eight months.

The standards will be located opposite each other on the streets at approximately 135 feet spacing. The height of the center of light source will be 20 feet. This Duo-flux system has never before been attempted and the outcome will be watched with interest by other cities which face a similar problem.

English Cannel Tunnel

The construction of the long proposed tunnel under the English Channel, from Dover to Calais is discussed in the London Times Sept. Engineering Supplement by J. V. Davies, New York, of the firm of Jacob & Davies, prominent tunnel engineers, employed on the construction of the Hudson Tubes, the Pennsylvania Railroad tunnels, the Consolidated Gas Co. tunnels and some of the Rapid Transit tunnels New York City. Mr. Davies estimates that the tunnel about 29 miles long between portals, could be driven through the chalk stratum under water 180 feet deep and at the section 24 miles long between the shore shafts could be excavated at the rate of 1,275 feet per month, thus requiring about 4 years for the headings to meet.

This estimates the attainment of a speed about 20 per cent greater than the best record yet made, namely, 932 feet in the Rogers Pass tunnel of the Canadian Pacific Railroad that was driven in 1913-1916 through soft slate shale.

The character of the rock which can probably be advantageously excavated by machinery, the moderate temperature that will be encountered, the location convenient to good labor markets and improvements in machinery and appliances are considered to justify this estimate which corresponds with a cost of about $150,000,000, nearly twice as much as was estimated before the war.

Timbering Deep Rock Shaft from Suspended Platform

A 14 x 5½-foot rock shaft in the Tintic District, Utah, was sunk 517 feet in 62 working days by the aid of a horizontal timber platform covering the entire area of the shaft and suspended by differential chain hoists from the timbering which was itself suspended, course by course, as the work proceeded.

This platform served as a scaffold for the timbermen to work on and prevented any objects dropping on the miners below. It was faced on the lower side with thin steel plates and was secured to the lower timbers of the bracings by wedged cramps or dogs. The shaft was lagged with 2-inch planks braced against longitudinal and transverse horizontal timbers that were separated by vertical spacers. The rock was drilled and blasted every 12 hours, the four men of each gang working alternately as miners or muckers, as required.

During the week ending February 7 snow in the street of Harrisburg, Pa., was removed by a force including 345 foremen, 2,285 laborers and 18 caretakers so that a total of 2,648 men was employed. The Highway Department had in use 35 automobile trucks on which snow plows were mounted. It also used 243 horse-drawn road machines. The same number of teams and wagons were in use, or a total of 521 vehicles.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

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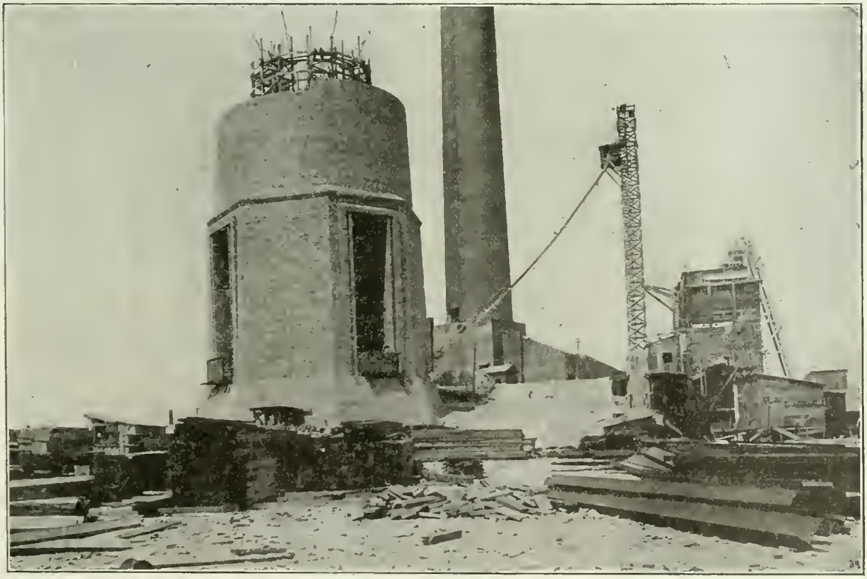
Anaconda Chimney Largest and Tallest in the World

30,000-ton brick structure 585 feet tall and sixty feet inside diameter at top, built with seven interior elevators installed in a full height falsework tower equipped with hand operated pipe derricks. Machine mixed mortar spouted to base of chimney. Methods employed illustrate operations applicable to construction of tall chimneys for waterworks, power plants and other purposes.

In order to precipitate substances previously carried off in smoke and thus reclaim a valuable amount of gold, silver and copper, a smoke treating plant has recently been completed for the Anaconda Copper Mining Co. at their Washoe Smelter at Anaconda, Montana. This system required for its operation a very much stronger draft than was provided by the existing chimney, 300 feet high and 30 feet in diameter at the top. A new chimney, 60 feet 2 inches interior top diameter and 585 feet high above the surface of the ground, has been built 200 feet distant from the old chimney by the Alphons Custodis Chimney Construction Co., of New York.



CONSTRUCTION OF NEW CHIMNEY WITH SEVEN INTERIOR ELEVATORS FOR BRICK AND FOR MORTAR DELIVERED TO BASE BY CONCRETE HOIST AND CHUTE. OLD 30x300-FOOT CHIMNEY ADJACENT.

The structure, which is said to be the largest and tallest of its kind in the world, has an octagonal brick base, 86 feet 7/8 inches in diameter at the top and 68 feet high, seated on a concrete footing, 99½ feet diameter at the base and 20 feet in maximum height and 13 feet in minimum height with the foundations terraced off at different elevations to give horizontal footings. The sub-structure is an octagonal wall 18 feet thick at the base in the deepest part and 8 feet thick at the top.

The superstructure consists of a slightly tapered shaft 86 feet 7/8 inches in diameter at the bottom with wall 64 inches thick at the base and 22¼ inches thick at the top just below the corbelling. The interior diameter diminishes from 86 feet ⅞ inches at the bottom to 60 feet, 2 inches at the top.

The shaft and base together weight about 30,000 tons and contain about 17,000 tons of special perforated radial bricks.

In the foundation there are apprximately 4,700 tons of broken stone, 1,750 cubic yards of sand and 10,350 barrels of cement were used.

RADIAL BRICK MANUFACTURE.

For the construction of this chimney there were required approximately 6,000,000 radial bricks, which were made by the Anaconda Copper Mining Company under the patent and supervision of the Custodis Chimney Construction Company.

Laboratory and practical tests of the Anaconda Co. had demonstrated the fact that the copper tailings, a hitherto waste product, was suitable for brick making, and these bricks were therefore made by the company in their existing brick plant. The tailings, which were of a finely ground pasty consistency, were delivered to the mixing machine and thence to a press from which it emerged through vertical steel dies, that formed the compound to the exact dimensions required for the bricks, delivering same in a continuous mass on a belt conveyor, where it was cut to the required depth by an automatic cutter, then removed, seasoned 24 hours in a hot air drier, transferred to the baking kilns for the desired period, and then stored until required for construction purposes. These radial bricks, which have a maximum size of about 10⅝ x 6¼ inches, have trapezoidal cross-sections perforated by several rectangular holes, which improve the joints and provide air spaces which act as insulation protecting the cold outer air from the warm air within. The bricks are of five different sizes with a minimum length of 4 inches. All of them were made in advance so that no delay was encountered in waiting for materials when the chimney was under construction.

FOUNDATION.

The foundation excavation, about 100 feet across, was carried down by hand owing to the shape of the cut, to a maximum depth of 15 feet on one side and 10 feet on the other side by pick and shovel work. Considerable blasting was necessary to trim off the soft and irregular rock surfaces into several horizontal benches.

After completing the excavation, the forms to receive the concrete mass were built up complete. The outer shell was braced by the backfilling and the inner shell was braced by heavy timbers extending across the entire core at top and bottom.

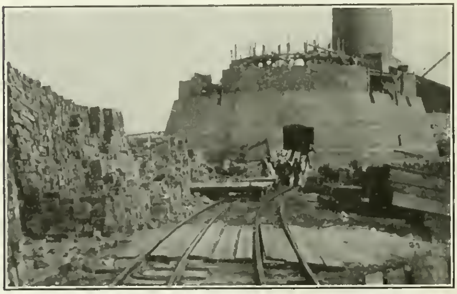
At the commencement of pouring operations, a mixing plant containing three large elevated hopper bottom storage bins, having a capacity of 30 to 40 cubic yards each, were constructed for sand, broken stone and cement. These materials were delivered on standard gauge cars, dumped into track hoppers and elevated by bucket elevator to the bins.

The bins delivered through bottom gates to a central charging hopper, which in turn dumped the proper proportion of aggregate into two one-yard mixers. Finished concrete was delivered to a one-yard bucket in a wooden hoisting tower, 115 feet high, from which it was spouted through steel chutes to the forms in the foundation pit.

Work was continuously prosecuted day and night until the sub-structure, containing about 5,000 yards of concrete, was completed in a solid monolithic mass to the required elevation. This work was accomplished in about eight days.

HOISTING AND SCAFFOLD TOWER.

After the completion of the concrete substructure, the irregular bottom of the interior core or well was surfaced with concrete to facilitate the movement of materials to the elevators and prepare a surface for the start of the tower which was laid out in the shape of a seven sided figure.


SPECIAL BRICK DELIVERED FROM STORAGE ON NARROW GAUGE SERVICE TRACKS.

In the bottom of the well 28 vertical 1-inch steel dowels projecting 12 inches above the concrete surface were set on the centers of 28 posts which formed the tower. The tower consisted of seven independent elevator shafts carried eventually 610 feet high, each built with four corner posts, beginning at the bottom with 10 x 10 inch timbers in 16 foot lengths with staggered joints spliced with four wooden scabs with two ⅞ inch bolts at each end of scab. These elevator towers were about 9 feet square on the inside. At a height of about 100 feet, the timbers were reduced to 8 x 10 inch; at a height of 175 feet, they were reduced to 8 x 8 inch; at a height of 250 feet, they were reduced to 6 x 8 inches; and at 325 feet, they were reduced to 6 x 6 inches.

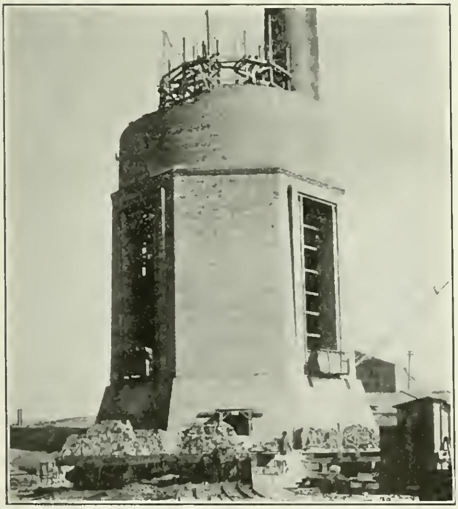
The towers were braced in themselves and to each other with X bracing and 2 x 8 inch horizontal struts at intervals of 5 feet vertically, that formed belt courses around the exterior and interior of the tower to correspond with the successive stages of the working scafforld. On these struts were placed putlock timbers running to the inside struts of the tower with a 6 inch bearing on finished brick work. Scaffold planks were laid on these putlock timbers and tacked down. Four by four inch strips were used as elevator guides, spiked to 2 x 8 inch struts.

The towers were built continuously by a regular force of five carpenters, that maintained them at an elevation of about 16 feet above the masons' working platform. The timbers were handled by light pipe derricks with short booms and hand windlasses. Each tower had this type of derrick.

The hoisting was done by three electrically-driven double drum hoists. Each hoist taking care of two elevators. Two of the hoists were driven by 90 h. p. motors. The four elevators connected to these hoists were elevated at a speed of 750 feet per minute. The other two elevators were connected to a 25 h. p. motor which elevated at slow speed and was used for hoisting men and heavy timbers.

DELIVERY OF BRICK AND MORTAR.

After completion of the concrete substructure, the storage bins for aggregate at the mixing plant were used for sand, fireclay and cement. This material was mixed in the two mixers and spouted to a 4 yard hopper at the base of the chimney. The material was loaded from this hopper into wheelbarrows, which were themselves sent up on elevators as fast as desired.



SPECIAL BRICKS DELIVERED DIRECT FROM KILN ON STANDARD GAUGE FLAT CARS.

Owing to the great volume of bricks that were made in advance of actual operations, it was found to effect an economy in handling to send a large number of the bricks to the site of erection. These bricks were sent up on standard gauge flat cars and piled as near as possible to site of erection. The great volume of bricks on the site, combined with timbering for the tower covered considerable area extending some distance from the chimney.

To overcome this long haul by hand a narrow gauge railway was laid down with several switches leading into a double track into the chimney. Platforms 15 feet long were bolted to two cars. Platform cars were then loaded with eight wheelbarrows of brick and heavy timbers, which were hauled into chimney by a small double drum engine with wire cable operated through a snatch block.

After the brick from outlying areas had been used it was found that this narrow gauge railroad was not economical for short hauls and it was abandoned. Standard gauge flat cars were loaded at the brick yard and brought within 20 feet of chimney, where they were unloaded partly on a platform and partly direct from the cars by hand.

BRICKLAYING.

The bricks were laid at an average rate of about 30,000 per day by a force of bricklayers running from fifteen to thirty men working one 8-hour shift. Usually, the men were located close together around one-half of the circumference of the chimney, building up 5 feet from each scaffold. As the men advanced and completed a portion of the lift the carpenters followed with their putlock timbers and flooring to get ready for the masons.

Notwithstanding considerable delay on account of high winds and the fumes from the other chimneys, the masons beginning with the progress of about 3 feet vertically per day finally attained a maximum speed of 5 feet with an average of perhaps 3½ feet during the process of construction.

The variable batter was accurately secured by use of batter boards, cut to the batter of the chimney, which were held against the outer face of the chimney and to which the bricklayers carefully pushed the bricks. Two men did this work.

The brickwork was commenced May 28th and finished November 11, 1918. After completing it, the interior towers and scaffolds were removed by a stiffleg derrick with 40 foot boom operated by a hoisting engine at the foot of the chimney. This derrick was made fast to one of the tower timbers by an encircling ring, wedged against it, holding it by friction, and enabling it to be easily lowered.

The contract of the Custodis Company was done under the general direction of W. C. Capron, mechanical superintendent of the Anaconda Copper Mining Co., Wm. Rutherford, resident manager.

The method of scaffolding tower was designed and operations were commenced under the personal direction of B. G. Laughton, construction engineer for the Custodis Company.

Slump Test for Road Concrete

A sample of the wet concrete is placed in a 6-inch steel pipe 12 inches long, open at both ends and seated on a horizontal board. The pipe is slowly and steadily raised vertically until it is clear of the concrete, when the latter, being deprived of horizontal support bulges out sideways, allowing the top surface to be depressed, an amount which should not exceed 4 inches for hand tamped concrete. For 60,000 yards of roadwork by the Marquette Construction Co., the engineers, Windes & Marsh, of Winnetka, Ill., used this apparatus, lifting the pipe with a simple portable hand windlass and found the slump rarely exceeded 2 inches.

Studying Manufacturing Wastes in Connecticut

Studies made in Connecticut on reducing pollution from plants engaged in manufacturing with metals, including recovery of metal from the waste, and prevention of nuisance. The view of the Connecticut State Board of Health concerning disposal by dilution is given.

About two years ago, following several years of agitation for reducing the pollution of the streams of Connecticut by manufacuring wastes, there was constituted a State Industrial Waste Board, composed of the State Department of Health, two manufacturers, two engineers and on representative from the State, at large, to study the problems involved and report to the next sesstion of the legislature. Most of the manufacturers co-operated heartily with this board, a number of them supplying means for carrying out in their works practical experiments necessary for the successful development of methods for recovering valuable by-products. In a general symposium on stream pollution before the Connecticut Society of Engineers, information was given concerning the progress made in this study.

RECOVERY OF METALS.

Both electrolytic and chemical methods were tested. In one plant, by electroplating, the copper content of the liquid was reduced from an average of 15 grams to 4 grams per liter, and zinc from 25 grams to 5 grams, with an equivalent recovery of sulphuric acid. On depositing the copper, the solution was neutralized with zinc oxide from flue dust, and the remaining copper and any cadmium were cemented out with scrap zinc. The small amounts of iron, arsenic and antimony present were removed by means of manganese dioxide and powdered limestone. The zinc was then deposited electrolytically from the pure sulphate solution. Careful cost estimates indicated that copper, zinc and sulphric acid could be recovered profitably from wastes, even on the basis of pre-war prices. It was evident, however, that this process would be profitable only in large plants where a cheap supply of zinc oxide from flue dust was available, and where there were a number of pickle tanks.

For other conditions, straight chemical processes are being studied, which include the recovery of copper by cementing it out of the liquor with scrap zinc, followed by evaporation of the purified wastes to produce zinc sulphate. The equipment for this process is much less extensive than for electrolytic treatment, thus making it applicable to small plants.

For treating wash water, a process is being tested which consists of neutralizing the free acid and precipitating copper and zinc with lime, the treated wash water being recirculated through the manufacturing plant, because of objections by manufacturers below to its discharge into the stream. So far no recovery of metals from the sludge has been secured and disposing of the sludge offers a serious problem.

While the board has not yet carried its studies to completion, James A. Newlands, who made the investigation for the board, believes that he is warranted in stating that metals can be recovered profitably from the wastes under consideration, but the proportion of metals and acids kept out of the streams by the processes is not sufficient to warrant their adoption on the basis of stream improvement; and that it is desirable, therefore, to continue the study of the problem with a view to developing such improvement.

THE HEALTH VIEWPOINT.

Considering the subject from the point of view of health, J. Frederick Jackson, director of the Bureau of Sanitary Engineering of the State Department of Health, in his contribution to the same symposium, emphasized the necessity for investigation of the *manufacturing* waste problem. While much yet remains to be learned concerning the final treatment of *domestic* wastes, yet the lines for future investigations are fairly well defined, and most of the recognized processes are quite well understood. But scarcely a beginning has been made in the treatment of industrial wastes. Such investigation is in a preliminary stage, and has been limited to a considerable extent to the laboratory, and has not been tried out on a commercial scale to a sufficient degree to permit the drawing of definite conclusions of general applicability.

It is only of comparatively recent years that stream pollution by trade wastes has become sufficiently intense to direct public attention to the necessity of preventing or minimizing it. It is, however, evident that immediate action is demanded in the case of many streams. Mr. Jackson believes that periodic examination of streams is desirable, so as to discover and correct conditions which, if permitted to persist without attention, will become so grave that they cannot be corrected without radical procedure and stringent legislation.

In making this investigation of the stream, the Health Board laid out the following program:

Location and establishment of gauging stations; cross sections of river bottom at each station; gauging stream flow; measurements of discharge from present sewer outfalls; census of industries on watershed and character and amount of their industrial waste; amount of water diverted from river for use in process of manufacturing. Analysis of water at different stations for dissolved oxygen, alkalinity and acidity, and bacteriological examination for the presence of colon; census of present population contributing sewage and estimate of future increase to compare with stream flow necessary to afford sufficient dilution to avoid nuisances; a study of the economic gain to industries using river water in process of manufacture by decreasing the alkalinity or acidity. The feasibility of establishing storage reservoirs on tributaries of the river sufficient to provide increased stream flow necessary for proper dilution. The feasibility of methods of treatment for reclaiming the wastes from the present processes of manufacture and using them as the raw material in the production of by-products, the sale of which would at least offset the cost of treatment.

Work under these different heads has been proceeding since the latter part of May, 1918.

Some of the problems affecting the study are the great complexity of the chemicals used by the different plants, with variations in quantities and character from hour to hour and day to day; the effect of the presence of copper upon bacteriological analysis and its action as a germicide; the effect of the daily variation in the flow of the stream; the influence of pondage in decreasing the pollution below dams and intensifying it through the accumulation of sludge above the dams; the effect of rapid and sluggish flow of streams, respectively; the amount of regulation on the stream by ponds and dams, etc.

"The solution would seem to be in partial treatment of both domestic and industrial wastes at their source, supplemented by such increased dilution as can be obtained from storage at reasonable cost."

MAKING ANALYSES OF RIVER WATER.

Discussing the chemical and bacteriological side of the investigation, Floyd W. Mohlman, chief chemist of the Chicago Sanitary Bureau, in the symposium above referred to described the general method of making chemical and bacterial analysis as follows:

"We have measured the concentration of pollution by determinations of dissolved oxygen, dissolved oxygen consumed in 48 hours at 20° C., ammonia nitrogen, total organic nitrogen, chlorine, alkalinity, total solids, suspended solids total bacteria at 20° C. and B. coli at 37½° C. The determinations of ammonia and organic nitrogen indicate the comparative concentration of organic matter in the water but do not necessarily indicate the liability of nuisance in the river at the place from which the sample was taken. The results of investigations of stream pollution made in the past have indicated that the concentration of dissolved oxygen and its rate of dissappearance when the water is incubated are correlated more closely with actual production of nuisance than are determinations of nitrogen, total solids or oxygen consumed from permanganate. It is well known that foul odors will be produced when there is no dissolved oxygen present in the water, as the anaerobic, odor-producing bacteria multiply under these conditions. There is a great difference of opinion among experts as to the amount of oxygen necessary to prevent odors in river waters, but it is usually assumed that no odors will be produced if there is over 40% of dissolved oxygen in the water. A larger amount is usually considered necessary in order to support major fish life, although some sanitary engineers claim that only a few per cent of saturation of dissolved oxygen will suffice. We have been rather surprised to find that of all tests for dissolved oxygen made on the Naugatuck River, the lowest average monthly per cent of saturation was 37%, below Torrington in August. Below Waterbury the lowest was 51% in August. The reason for this unexpectedly large amount of oxygen at places shown to be highly polluted by other tests, is due to riffles in the stream, which introduce a temporarily large amount of atmospheric oxygen into the water. We have found that in a stream such as the Naugatuck, with its swift flow, the determination of dissolved oxygen in the field did not indicate the amount of contamination in a given sample or its possibility of nuisance. We have found that the consumption of dissolved oxygen in forty-eight hours at 20° C. was a very fair relative test of pollution, as in such a procedure the actual condition of the sample is shown with regard to its liability toward putrefaction, and transitory effects of aeration are eleminated. We have found that 95% of the dissolved oxygen was frequently consumed in forty-eight hours in samples from the more polluted places during the summer months, while only 20% was consumed during the winter months in samples from these same stations.

PREVENTING NUISANCE.

The board is attempting to calculate the stream flow necessary at critical points in order to prevent nuisance, but finds it a different procedure because, first, there is such a difference of opinion among sanitary engineers as to the proper standard above which nuisance will occur, and, second, no entirely satisfactory method of computation is known by which it may be determined how much a sample with a given dissolved oxygen consumption must be diluted in order to bring the consumption down to the value set as a standard. The board is working on these problems, and is convinced that the necessary dilution can be calculated best from the results of this determination of dissolved oxygen consumption, rather than on the basis of so many second-feet per thousand population contributing sewage, or from the determination of nitrogen or chlorine. He agrees with the British Royal Sewage Commission that a clean water should not take up more than 2.0 parts per million of dissolved oxygen in five days at 18.3° C., and that a water which takes up 4.0 parts in five days is not fit for use as a diluting water, and is on the verge of becoming a nuisance itself.

A great deal of nuisance comes from deposits of suspended matter on sand bars and the bottoms of mill ponds. Many of the latter act as sceptic tanks. Mud from the bottom of one pond had a dissolved oxygen demand of about 8,000 parts per million, or 20 to 80 times as much as raw sewage. Incidentally, it was found that this mud contained 17.8 pounds of copper per ton of dry mud, worth $4.63 under war prices.

Referring to the popular impression that acids in rivers practically sterilize them, Mr. Mohlman said that they had found as many as 6,300,000 bacteria per c. c. in the river water, and that the average of every station in the Naugatuck river from Waterbury to the mouth, in July, was well above 1,000,000 per c. c.

B. coli are destroyed by copper wastes, however, and probably any pathogenic organisms associated with them, only from 3 to 72 B. coli per c. c. having been found in the samples. It is probable that the B. coli are killed off very quickly, after which the copper is precipitated, and the saprophitic forms multiply very rapidly. This phenomenon is similar to the great increase in bacteria in reservoirs following treatment with copper sulphate as an algicide, or to the after growths found in water supplies that have been treated with chlorine.

Acid wastes delay the normal processes of stream purification until the copper has been precipitated, and they thus serve to carry unoxidized organic matter farther down stream than would be the case if they were absent.

DISPOSAL BY DILUTION.

The board believes that the policy of using a river to its maximum capacity as a purifier of trade wastes and sewages, without at the same time causing nuisance, is more rational than one which demands that all wastes and sewages be treated to such a degree that they will not affect the condition of the stream in any way. The streams can never be restored to their original state of purity and in the lower reaches of populous districts will probably never be used as sources of water supply. It is believed, however, that they should be cleaned up to such an extent that they will not be noticeably obnoxious and odorous during the summer months.

Terrific Flames Extinguished by Dynamite

On July 26, 1919, while one of the Standard Oil Company's wells near Taft, California, was producing 180,000,000 cubic feet of gas under enormous pressure every 24 hours the friction of sand on 8,135 feet of 10-inch casing pipes heated the latter red hot and ignited the gas before the casing could be valved and the flow controlled.

The enormous flames, 50 feet wide and 300 feet high, commenced at a point 12 feet above the top of the casing and produced such an intense heat as to melt metal at the casing and make it quite hot for a radius of 50 feet. The roar of the gas could be heard ten miles and the flames could be seen 80 miles. Shouting could not be heard within a distance of 1,000 feet from the well, near which it was, of course, impossible to work.

For nine days and nights strenuous efforts were made to extinguish the flames, and at the fourth attempt 20 steam boilers and 11 rotary pumps threw twenty-one 3-inch and nine 4-inch lines of steam, water, mud and carbon tetrachloride on the flames without avail. Artillery officers of the U. S. Army declared the flames too great to be extinguished by bombarding with field artillery, and after the expenditure of nearly $500,000 all efforts to extinguish the flames had been in vain.

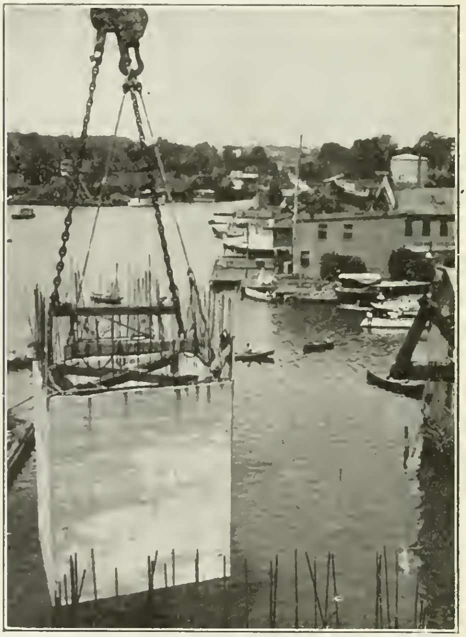
On the tenth day an attempt was made by Ford Alexander, expert oil well blaster, to extinguish the flames by explosives. A 40-foot derrick was installed on each side of the well, beyond the radius of extreme heat, and a 9/16-inch steel cable was passed through sheaves on their tops and laid on the ground between them outside the super-heated zone.

About 150 pounds of Giant blasting gelatine, heavily wrapped in asbestos, was attached to the cable, and the latter, being operated by a hoisting engine at one end, rapidly lifted the explosive from the ground and hauled it to a position over the well, where it was quickly exploded by electricity, the operations being controlled by Mr. Alexander, who had approached within 200 feet of the well under protection of a steel screen cooled by a 3-inch hose stream.

The explosion divided the huge torch of flames into three distinct portions, one of which was displaced horizontally and the other vertically until they died away; while the third, or lower portion, was snuffed out like a candle.

Derrick Sets 150-Ton Concrete Box in Water 25 Feet Deep

Two precast boxes of reinforced concrete form the well-like structure that houses the three centrifugal pumps used to handle the condensing water in the generating plant of the Stamford, Conn., Gas & Electric Company on Long Island Sound. These pumps are located at the bottom of this 25-foot well structure in water 12 feet deep at low tide, with a range in tide of 13 feet. The boxes, each 30 by 21 feet in plan, were cast on shore, then handled by a heavy wrecking derrick, which lowered them in place onto a foundation that divers had leveled and made ready. The walls are 12 inches thick, the bottom 18 inches, and there is an inner cross-wall 14 inches thick separating the screen chamber from the pump well proper.



BOX SUSPENDED FROM BOOM BY TWO BRIDLES.

Jersey City Coal Pier 1,100,000 Yd. Hydraulic Fill

Slip 30 feet deep and large high fill made by 22-inch suction dredge. Mud, sand and stones moved as much as one mile horizontally, elevated to a maximum height of 53 feet and deposited behind successive tiers of 5-foot earth levees at an average rate of 150,000 yards per month, and at a cost of about 30 cents per yard.

The construction on the shore of the Hudson River at Jersey City of a coal storage pier, No. 18, with capacity for handling 400 cars in 8 hours for the New Jersey Central Railroad, involved the improvement of the slip and channel by dredging to a depth of 30 feet below mean low water and grading part of the land at the shore end of the pier originally from nothing to 8 feet above water level, up to an elevation of 23 feet. This involved dredging about 1,100,000 yards of earth and sand which was accomplished by one 22-inch hydraulic dredge in about 8 months for a price of about $320,000.

The pier was designed and constructed under the direction of the Engineering Department of the Central R. R. of N. J., A. E. Owen, Chief Engineer. The Atlantic, Gulf & Pacific Co., New York, was the contractor for the dredging and hydraulic fill which was commenced June 1918 and completed in February 1919 at a contract price of 29 cents per cubic yard, place measurement in the cut.

GENERAL CONDITIONS.

The building of the pier included extensive improvements on the property owned by the railroad company between its existing piers on the water front where the land in-shore of the Government bulkhead line was partly submerged and partly had an irregular surface slightly elevated above mean high water. It was desired to excavate some of the submerged land so as to increase the depth of water from about 6 feet to 30 feet at low tide, making a slip for large vessels in an area about 400 feet wide and 3,000 feet long and to build up the adjacent area about 400 feet wide and 3,500 feet long to a minimum elevation of 5 feet above high tide, sloping up to a maximum elevation of about 23 feet above high tide so as to provide for the storage, shifting and classification yards having a capacity for a large number of coal cars, and form a ramp or hump on which the dumping machines are located to provide for returning the empty cars to the storage yards by gravity.

At this place the bottom of the river consisted of mud, sand and hard gravel approximately equivalent to hardpan, overlaid with a stratum of soft mud 5 or 10 feet thick. Below the mud loose stones of moderate size were found, but there were no sunken wrecks or other serious obstruction encountered. About 275,000 yards of sand dredged from the piers of the Brooklyn Army Base by dipper and bucket machines were transported to the Jersey City Pier site, dumped in water from 15 to 30 feet deep in front of the dredge, and by it pumped up and delivered on the pier site, for additional fill.

DREDGE AND PIPE LINE.

All of the fill was handled by the contractor's 22-inch hydraulic dredge "Clinton" which worked from in-shore out, depositing the fill from outshore in. From the dredge to the edge of the pier the pump discharged through a 22-inch floating pipe line about 1,000 feet long with ball and socket joints supported on steel pontoons. This pipe was supported beyond the pier line on about 2,200 feet of pile trestle, provided by the railroad company, parallel to the center line of the pier.

At the in-shore end of this trestle a discharge pipe was provided with a valved Y, each branch of which was extended as necessary beyond the valve, one of them being in service while the other was cut off and the pipe extended or shifted as required. In this way the water and solid materials were distributed over the pier.

As it became necessary, and during the time when the dredge itself was undergoing repairs, the Y-valves were moved further out in the fill in order to reduce the number of pipe necessary in handling the job by increasing the length of the single line and reducing the length of the two branch lines.

The land pipe was made of 3/16-inch riveted steel plates in sections 16 feet 6 inches long and was connected by telescopic joints with an overlap of about 6 inches. Joints were quickly made and broken by three or more men with bars, and were sometimes secured by lashings around lugs riveted to the ends of the pipe sections. These lashings, however, were frequently omitted. The total length of the discharge pipe varied with the position of the dredge and the advance of the fill, and attained a maximum of about one mile. The water and solid material were pumped to a maximum elevation of 23 feet and from a maximum depth of 30 feet at mean low water.

LEVEES.

The fill being deposited from the discharge pipe in a fluid condition in shallow water and on low flat ground was retained by earth levees started in advance of the pumping and continued and maintained as the fill progressed. Two levees about 4,000 feet long were built on opposite sides of the pier area, approximately perpendicular to the bulkhead line and were connected at the river end by a transverse levee about 400 feet long. The levees were built by shovel gangs, the material being obtained from two parallel ditches 5 feet wide, 3 feet deep, and 20 feet apart in the clear for each levee.

In order to reduce the amount of levee work the original levees were built only about 5 feet high, and after the fill had reached approximately this elevation additional levees were constructed on top of the fill. The two levees thus constructed having considerably less yardage per foot than would have been necessary if the original levee had been constructed to the final height.

When the flow from the dredge discharge pipe approached the top of the levee or threatened to wash it away, the levees were protected by splash boards in sections 12 feet long, each panel of which was made from three or four 1 x 10-inch horizontal planks nailed to transverse cleats projecting beyond one edge to form stakes which were set in the ground to maintain the boards in vertical positions. Men working behind these boards built up the top of the levee to the required elevation.

EFFLUENT AND SEDIMENT.

The discharge pipe was so handled as to distribute the material over the surface of the fill at an approximately uniform grade of about 1 per cent, bringing the summit at about the required location for the top of the specified hump. After this fill was made, it was necessary to cut through it for the location of a low grade railroad track, and the excavation was made by a steam shovel which removed enough material (about 100,000 yards) to build up the summit of the hydraulic fill to the required elevation for the top of the hump.

After depositing the dredged material between the levees, the effluent water from the discharge pipe flowed through a sluice-way 20 feet wide, 2 feet deep and 500 or 600 feet long that was cut at the shore end of the fill site and discharged into an unimproved tract about 4,000 feet long that belonged to the railroad company and was enclosed at the river end by a dam with a sluiceway in it, thus providing for the settlement of any matter that had remained suspended in the water and not only prevented its return to the dredge basin but to a substantial degree filled up the low land behind the dam.

During the time that the levee was under construction the maximum force of the dredge contractor was about 160 men, which was much reduced when there was no levee building. The dredge was equipped with a steel ladder and a six-blade cast steel cutter so that hard material could be handled and stones with their greatest dimensions only slightly less than the diameter of the discharge pipe were often pumped under the fill. The maximum rate of dredging was about 150,000 yards per month.

The public service commission, New York, has ordered the Long Island Rail Company to construct a new bridge over Flushing river at Flushing and to submit plans for the same to the commission within sixty days.

75-ton Excavator Crosses the Rio Grande

The Rio Grande River has such a treacherous bed that it is a very easy matter for any heavy object to find quicksand and slip down into it. That is why much credit is due to the engineers of the U. S. Reclamation Service for their skill in taking across the river without mishap a dragline excavator weighing 150,000 pounds. It was necessary to move the outfit from the west to the east side of the river at Mesquite.

This No. 9 execavator, which is similar to seven others on the Rio Grande project, is a dragline with a 1½ yard bucket, and is equipped with a 125 horse-power marine engine weighing 7 tons and a caterpillar tractor.

The excavator was taken from one bank to another, a distance of nearly 1,000 feet, in 6 hours 30 minutes. The transfer was made over a continuous timber platform, securely guyed.

EXCAVATOR EMERGING FROM DEEP WATER.

The operation was under the direct supervision of N. E. Fordham, master mechanic of the Rio Grande project, who has been recommended by officials of the service for his good work.

Change of Name

How It Strikes Our Friends.

"I see by your cover you've changed your name,
But the good you've been doing, remains the same.
Each issue contains interesting news,
What is being done, how you can choose
The best method, the best course to pursue
When problems arise, the best thing to do—
In emergency cases, complicated, or bad,
Your various departments, are only too glad
To help your readers, or managers out
In the East, the West, the North, or South.
By professional advice from competent men,
Employed by you, to help now and then
The different communities, when troubles arise.
You are always willing and glad to advise,
Where, when, and how, you can buy
The necessary articles, if your advs. they try
To remedy their troubles wherever it lurks
Can be purchased through the PUBLIC WORKS."

—*P. J. Egan.*

The city of Davenport established a new record in 1919 for laying 10½ miles of pavement, nearly all of it having a 2-inch top of asphaltic concrete on a 5-inch concrete base, the whole weighing 59 pounds and cost $3 per square yard.

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A. PRESCOTT FOLWELL, *Editor*
FRANK W. SKINNER, *Associate Editor*

Use More Labor-Saving Equipment

The world-wide pestilence of extravagance, idleness and disaffection, aggravating the frightful war destruction of life, property and organization, are leading to revolutions in utility, municipal, industrial and construction matters as well as in social, financial and political directions. Eventually an adjustment will inevitably be made on the bed rock basis of supply and demand but meantime the socialistic or Bolshevik mania persists and increases, and is rapidly consuming the reserves and safeguards of all kinds of production and progress; inflation continues, and the decreasing value of capital and the unwillingness of labor and of many producers and middlemen to give fair equivalents make new methods and principles necessary.

The scarcity, poor quality, disaffection and complete unreliability of a large percentage of labor renders it a most difficult factor to be reckoned with and necessitates its education, classification, conservation, and that it be held legally and financially responsible for the performance of its contracts and made to obey the statutes of the country from which all class legislation should be eliminated.

But these measures alone will not suffice. The loss of ten million lives, and the destruction of billions of dollars' worth of property within the last six years has set the world so far back and has created such a deficiency of man power, that there will long remain a scarcity of labor, particularly in this country which has depended to so large an extent on immigration, that it will be absolutely necessary to substitute to the largest extent mechanical devices for man power. Wherever, therefore, mechanical equipment can be substituted for hand labor in public operations and the maintenance of utilities, as for instance in handling materials, stoking boilers, sweeping streets, and all other routine operations; where it can be employed in construction work, as in excavating, concrete mixing, paving, surfacing, etc.; or where small tools can be operated by power instead of by hand, and for numerous other services, machinery and power plants should be installed.

The wide distribution of electric power from central stations enables a large amount of machinery to be advantageously driven by it even when there is an apparent disadvantage in unit cost, because of the greater convenience and less waste incurred. Because of cheaper production and transmission and improved appliances, electricity is rapidly being adapted to heavy machinery, including the operation of steam shovels. Where it is not available, improved oil, gasoline and gas motors are often very convenient and for groups of machines or tools compressed air is frequently economical, while steam can be generated at any point where coal or wood is available and in remote or mountainous localities it is often possible to install hydro-electric equipment or hydraulic power to great advantage even for temporary operations.

Power plant and machine tools should be selected not only with a view to their efficiency, but to their adaptability for various operations, for their ultimate salvage and rental value, for the economy of maintenance and with consideration of the class of operators required for them and for auxiliary service.

It should also be remembered that the plant and machines never go on strike; never demand higher wages: with good treatment will work day and night and Sundays almost continuously; can be depended on in an emergency; and when working from twelve to twenty-four hours per day greatly decrease fixed and overhead charges and many risks. Besides this, the direct cost of the work they perform consists only of interest, depreciation, repairs, transportation and attendance, the sum of which is often many times less than the sum of the wages of an equivalent force of hand laborers. Efficient power plant constantly used is therefore a most valuable investment and insurance policy.

Retaining Percentage of Construction Funds Unnecessary

Since 1850 it is said that periods of business depression and unemployment in this country are recurrent at intervals of about 10 years, but this is only comparative unemployment: there is seldom a serious excess of good labor in this country taken as a whole. As the present normal expenditure for public works construction is estimated at about $1,000,000,000 per year, it has been suggested that nine-tenths of this sum be expended in each current year and that the remaining tenth be deposited in a sinking fund held in reserve to maintain construction activity in the periodical dull time.

Such a policy might be good if necessary and if this country were impoverished or had limited resources, but with the enormous wealth, and its gold reserve that exceeds 50 per cent. of that in the entire world, it seems harly necessary unless it might act as a good example for economy that is certainly needed to curb the inordinate extravagances that have overwhelmed almost all recent public enterprises.

What we do want is to have the hundreds of millions of dollars already available, spent promptly and judiciously and to secure full value for every dollar paid out of the public treasury. These results combined with a universal scale of proportionate equality of wages and salaries corresponding to the actual efficiency of the employed would go far almost towards difficult industrial problems.

The Fruits of Unfair Municipal Treatment

Several authoritative statements published in this issue regarding the operation of transit facilities in Greater New York and vicinity illuminate the general subject of treatment of public utilities by the municipality. After reporting that the Interborough Rapid Transit Co. operates the subway to its maximum capacity during rush hours, Public Service Commissioner Lewis Nixon directs them to increase the non-rush hour service by the addition of 600 cars, which is apparently the principal improvement that he finds it practical to make immediately in the transportation of the millions of passengers that have increasingly overburdened the transit lines since their construction.

This action may be considered as refuting in great measure the charges of gross and wilful inefficiency, the hurling of which at the subway and surface lines has been a favorite indoor sport for politicians and soreheads. The fact is that the New York transit system, while safely and rapidly handling an unprecedented volume of traffic, has so much stimulated the growth of the city that congestion has increased more rapidly than relief could be provided for it, so that in reality the more subways, the less comfort to the travelers, and the system has not yet seen much indication of catching up with the rapidly increasing requirements.

In the midst of this difficult condition, expenses have been so vastly increased that the companies have pleaded for increased fares, which have been granted in so many parts of the country, but which have been arrogantly refused consideration here. Mr. Nixon further reports concerning this, that the Interborough, as a system, cannot avoid a receivership without relief, and that it is doubtful if the Brooklyn Rapid Transit can operate at a 5 cent fare without defaulting on interest, to say nothing of making a profit.

Furthermore, the president of trolley lines in the same district offers them as a free gift to the city, provided the latter will operate them at a 5 cent fare, opportunity which the politicians, greedy for graft and patronage, may be expected to look longingly at without being much disturbed by the heavy additional expenses that would cause a deficit which would merely add a heavy burden to the taxpayers. Where both the expenses and the revenue of any business concern are arbitrarily controlled by influence which they cannot govern, such a result is sooner or later inevitable for any public utility.

The Gentle Art of Highwaymanship

Labor profiteering is now a more or less profitable example of the gentle art of highwaymanship than it was during the war emergency. According to statistics of the Hoboken Ship & Repair Yard of the New York and New Jersey Dry Dock Association, published in the Journal of Commerce, more than 60 per cent. of the pay received by a force of over 3,000 men was for overtime. In ten out of eleven different classes, the men drew more pay for overtime than for straight time. The classes included carpenters, caulkers, deckhands, engineers, painters, machinists, electricians, blacksmiths, pipe-fitters, iron workers and riggers. The percentage of overtime varied from 50.02 for the caulkers to 68.04 for pipe-fitters.

The figures were all taken on the present basis, and the job which cost about $377,000, would only have cost $332,000 had it all been done on straight time.

In 1914 the average weekly pay of the machinist was, for straight time $19.68, for overtime $9.43. At present it is for straight time $41.47, for overtime $40.26, making $91.73 per week equal to a raise of 180 per cent. since 1914 while the helpers have received a raise of 274 per cent. As the high cost of living is estimated to have advanced 110 per cent. since the beginning of the war, the machinist's pay has risen 70 per cent. above the cost of living and the helpers have risen 164 per cent. above the cost of living. Notwithstanding these facts, the men are claiming a farther advance of 25 per cent. pay, a larger quantity of overtime which if granted would raise the average machinist's pay to $102.14 per week.

With these facts must be considered the decreased efficiency and the shorter working hours that delay the work at an enormously increased risk and overhead and it is easy to see to what conditions autocratic interference, initiated by the pernicious Adamson bill, and succeeding granting of confiscatory wages to turbulent labor, has subjected all business interests, and how it injures every class in the nation except the organized laborers who have thus been criminally subsidized for contemptible political motives.

Specifics for Labor Troubles

When this country has suffered enough from restricted production, inflated prices, insecurity of capital, destruction of industrial and construction interests and the general ravages of labor tyranny and robbery; when the surplus and reserve funds, the fruits of energy, economy and enterprise have been sufficiently dissipated, and perhaps not until the whole country has been plunged in terrific misery, will we see and acknowledge the two great remedies for the strike leprosy.

These are, first, the compulsory incorporation of all labor unions and organizations with restrictions compelling them to maintain resources available for fines and penalties so that they will be held to their solemn covenants equally with the employer participants and, second, when in every case, the existing laws throughout the country are universally enforced without fear or favor, to prevent and punish all kinds of violence, conspiracy and intimidation, whether by individuals or organizations. No classes will then be exempt from the actions of these laws as is now notably the case while farmers and labor unions are specifically excepted from important laws that, in their partial administration are a weapon of political schemers and a terrible menace to the safety and prosperity of the nation.

In 1919, the state of New Hampshire, commenced construction of 72 new highway projects involving 92 miles of road and, it is expected will expend $1,250,000 on the construction of 110 miles of new highway, much of which will be finished in 1920.

Kenova Viaduct Erection

Single Track Girder Structure Under Heavy Traffic Replaced by Double Track Structure on Same Foundation. Sets of Three 31- and 61-Foot Spans Were Successively Supported by Overhead Traveler While New Centre Viaduct Towers Were Built Under Them and Girders Afterwards Replaced Without Interrupting Train Service.

The replacement of a railroad girder viaduct by a new structure in the same position has always been considered a very difficult problem when it was required to solve it without interrupting traffic over the old structure. About the only way to accomplish it, when it is inadmissible to by-pass the traffic, is either to build falsework to support these tracks or to adopt some means of displacing sections of the old original structure and immediately replacing them by completed sections of the new structure that can be connected up and put in service between trains, or by taking out the members of the old structure piecemeal and replacing them by new members, an operation, which, while simple enough for the longitudinal girders, is obviously much more difficult for the transverse girders and tower members.

All of the difficulties were satisfactorily overcome in the reconstruction of the approach viaduct of the Norfolk & Western Railway at the West Virginia end of its bridge across the Ohio river at Kenova, West Virginia. The old single track structure, about 2,148 feet long, consisted of sixty 30-foot 8¼-inch spans and one 61-foot 4½-inch span supported on 30-foot steel towers from 20 to 50 feet high, and at the time of reconstruction carried a traffic of about 72 50- to 75-car coal trains daily.

The old single track structure was replaced on practically the same alignment, but at a somewhat higher elevation by a double-track plate girder structure with spans of the same lengths calculated to support a much heavier load. Successive sets of three of the old spans were temporarily supported by an overhead traveler while the old tower under the centre span was removed and new transverse beams inserted in its place, after which the new towers were completed while traffic still passed over the old girders that were later removed between trains, simultaneous with the erection of new girders and the shifting of the tracks to them so that the train service was practically uninterrupted during reconstruction.

FALSEWORK, DERRICK AND TRANSFER.

Operations were commenced by jacking up the old viaduct until the track was at the required new grade and supporting the tower columns on wooden blocking on the concrete pedestals that later received the columns for the new viaduct. A derrick was installed on the pier at the north end of the viaduct, erected falsework in the two adjacent panels of the viaduct and on it assembled the first two spans of the new double-track structure which consisted of four-column towers each with two traverse girders carrying the four lines of longitudinal girders.

The derrick also erected on the first two spans of the new structure a wooden tower traveler with one 80-foot and one 65-foot 12-ton steel derrick booms operated by a hoisting engine on a working platform elevated 21½ feet above the rails and giving clearance under it for train service on the old track. The derrick advanced on rails laid over the outside girders of the new structure. Material for the new viaduct was delivered on a service track laid on the ground parallel and adjacent to the old viaduct.

ERECTING AND REPLACING TOWER.

The columns, girders and cross-bracing for the two tranverse bents of the second new tower were erected in vertical position on blocking, level with the tops of the concrete pedestals and were temporarily braced in position while the transverse bents of the first old tower were also braced to support them while the longitudinal bracing of the tower was removed.

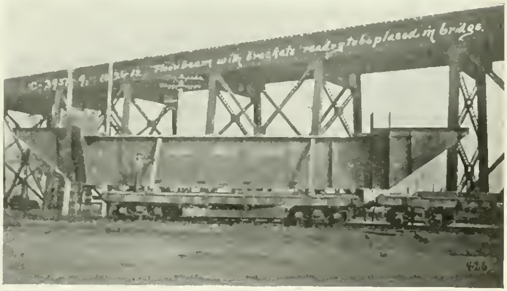
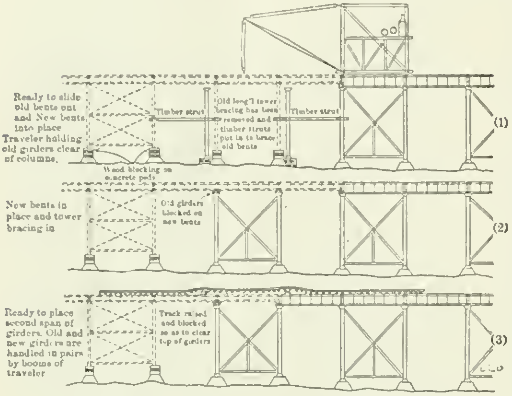


PLATE GIRDER VIADUCT AND TRUSS FROM CROSS BEAM.

The old longitudinal girders were securely fastened together end to end over the transverse bents, were detached from the latter and were raised a few inches to clear them by the tackles suspended from both booms of the traveler. This permitted the two old bents to be skidded transversely clear of the new viaducts by lines operated from the hoisting engine on the traveler which also skidded the new bents into the position where they were braced temporarily with wooden struts. All girders were lowered to temporary support on top of the new bents and train service continued, the operations having been conducted during an interval between regular trains.

REPLACING LONGITUDINAL GIRDERS.

The new transverse bents were braced longitudinally to complete the tower and the old tower bents were cut to pieces. The new longitudinal girders were shipped from the bridge shop in pairs with cross bracing and diagonals riveted up complete. The track on the first span of the old girders was lifted at both ends and blocked up high enough to clear the entire length of the span, which being disconnected at the forward end was removed as a unit by one of the derrick booms while the other boom lifted from the ground and set in position on the new tower, the new pair of braced center girders. The outside girders, shipped separately, were erected, one by each boom, and traveler rails laid on them. The track was then again lifted at both ends, the blocking under it removed and the track lowered to final position on the new girders. Train service was then admitted to cross this span, and in the second span of old girders were replaced by new ones in the same manner, after which the traveler advanced two spans and repeated the operation and so on.


Ready to slide old bents out and New bents into place
Traveler holding old girders clear of columns.
Wood blocking on concrete pads
Timber strut
Old long'l tower bracing has been removed and timber struts put in to brace old bents
Timber strut
(1)
New bents in place and tower bracing in
Old girders blocked on new bents
(2)
Ready to place second span of girders. Old and new girders are handled in pairs by booms of traveler
Track raised and blocked so as to clear top of girders
(3)

SEQUENCE OF OPERATIONS IN REPLACING SINGLE TRACK VIADUCT BY DOUBLE TRACK STRUCTURE WITH SAME SPAN LENGTHS.

As all of these operations could be done in 20-minute intervals between regular trains and as none of them were commenced if a train was in sight, it was seldom necessary to hold trains at all and never for more than a few moments, and the work was carried on at the rate of two spans, or about 60 feet per day.

The new viaduct was fabricated and erected by The American Bridge Company, Wm. G. Grove and Henry Taylor, assistant engineers in charge. The engraving, illustrating the traveler and the old and new structures, the former indicated by dotted lines, is reprinted from the transactions of the American Society of Civil Engineers, Vol .79, Page 418.

Official Plan for New York Transit Companies Relief

Lewis Nixon, Public Service Commissioner for the First District, has submitted to the New York State Legislature a special report upon the traction situation in New York City in response to a concurrent resolution of the Legislature asking for such information. The report covers the results arrived at by Commissioner Nixon in his investigations as to whether it is possible for the traction companies to render adequate service at the present rate of fare. The report concludes that the Interborough subway, if operated as a single unit, could possibly survive under the present rate of fare, but that as a system it cannot avoid a receivership except by subordination of interest charges and through outside revenue. He finds that it is doubtful whether the New York Consolidated Railroad Company (B. R. T.) can continue at the present rate of fare as the contracts now are and pay interest on the bonds. He also states that it seems clear that the surface car lines throughout the city must have more revenue or their deterioration and disintegration will continue progressively. The report suggests a plan of reorganization of all the companies into one company for the entire city; or, if that is not possible, into two companies, one serving the Interborough Rapid Transit area and one the Brooklyn Rapid Transit area. Any increases in fare for the companies should be accompanied by corresponding concessions from them. A flexible cost of service fare should be established for a period of six months, all receipts therefrom to be used for cost of operation and maintenance, and not at all for dividends.

Trolley Lines Offered as a Free Gift

George A. Stanley, president of the New York and North Shore Traction Company, operating trolley lines from Flushing to Whitestone, and to Hicksville, in Nassau County, has offered his line to the city as a gift if the city will operate the road at a five-cent fare. He made this proffer at a hearing before the Public Service Commission for the First District, called to investigate the action of the company in ceasing service over all its lines. He stated that at many points the company's tracks were buried beneath several inches, and in some cases several feet, of ice, and that the company had no money with which to remove the encumbrances. He stated, however, that he was willing to resume service immediately after the snow had melted and the tracks were clear.

Combined Curb and Gutter Construction Method

Hanlon & Okes, contractors for paving at Worthington, Minn., have effected a considerable economy of labor by developing an improved method of making a monolithic curb and gutter. This is concreted in the usual manner in side forms with a 1x1½-inch continuous steel guide bar set against the inner space of the curb form at the top. After the concrete has been placed, the upper surfaces of curb and gutter with slope and fillet connecting them are covered with cement mortar and the latter is accurately screened by a transverse template with steel bearing surface, that is attached to a wooden cradle supported on the upper edges of the curb and gutter forms and kept in alignment by the guide strip. This provides for the required slope, curve and horizontal surfaces without floating and with very little troweling to satisfactorily finish them.

State Highway Construction in New York

By Jas. H. Sturdevant *

The first of three articles. In this one are described methods and appliances for making the survey, grading and rock excavation, and other features of the work required for preparing the sub-grade.

In New York State the state commissioner has entire jurisdiction over the location and construction of state highways and Federal routes, while the various boards of supervisors designate the roads and the order of construction of county roads, toward which they pay a percentage of cost; this percentage being based on area, mileage and assessed valuation, and varies for the different counties.

All new construction is performed by contract, and it is desirable to let the work in sections of five miles or more so as to justify the installation of first-class equipment for rapidly progressing the work. Under normal conditions a single concreting plant should build at least this amount of mileage of road surface during the working season.

ENGINEERING ORGANIZATION.

The organization of the New York State Highway Department consists of the commissioner, Capt. Frederick Stuart Greene, a first deputy in charge of new construction and maintenance, and a third deputy in charge of town and county roadwork. The state is divided into nine divisions, each in charge of a division engineer, with the necessary force of draftsmen, inspectors, etc., making for the entire department a personnel of over 1,000 men. In the first division, embracing the territory both sides of the Hudson river southerly from Albany to the end of Long Island, excepting New York City, there is a division engineer with headquarters at Poughkeepsie, three resident engineers, twelve county assistants, and from one hundred to one hundred and fifty engineers and inspectors, who have supervision of all the highway work in that division.

As most of the state roads are in well settled and easily accessible localities, reconstruction and new construction vary but little, except that the latter involves more clearing, grading and draining than the former; and in this discussion all of the elements that enter into new construction will be considered, although some of them may be absent in reconstruction work, even when the latter may substantially give an entirely new type of road.

The principal operations of road construction are survey, design, drainage, surfacing, and the necessary accompanying structures.

SURVEY.

In level, unobstructed country the roads may usually be located with a single survey, but in very hilly countries, or where there are many difficulties and obstructions such as ravines, rivers, swamps, buildings, railroads or other structures, it may be necessary to survey several lines, take levels and establish contours for an accurate typographical map on which the several lines are plotted, estimates made and the most advantageous location finally selected.

The base line of the survey should be definitely located by transit points tied in by horizontal measurements to at least three permanent tie points, well marked for future use in locating the new center line for construction. To this base line are referenced all structures, property lines, buildings, walls, etc. Cross-sections should be taken at least every 100 ft., and oftener if necessary to show breaks in grade, high banks, rock, etc. Permanent bench marks should be established not over 1,000 ft. apart, and may be made by chiseling crosses on ledge rock or large boulders, or by driving copper nails in bases of trees or permanent structures.

In locating a line, consideration must be given, of course, to materials and local conditions. The contracts should specify the quality and character of all materials and labor, describe the important operations, and give all the rules and requirements which the contractor must observe. They should particularly specify the mixing, placing and finishing of concrete or other road surface materials, and define the contractors' privileges and liabilities. The contractor should receive at least two copies of the specifications and blue prints showing all plans, profile, cross sections, structures and other details. For a permanent record, all details of final construction should be indicated on a set of prints mounted on cloth.

GRADING.

From the time that the grading is commenced, the assistant engineer or inspector in charge should be present constantly, and should stake well in advance of the construction; locating alignment and slopes, the latter having stakes driven about 100 ft. apart on each side of the center line and far enough away from it to be clear of construction operations and to afford permanent references when the center line stakes are necessarily removed. The side stakes should be inscribed with elevations and amount of cut or fill necessary, to enable the contractor with grade board and string to get the rough grading ready for instrumental checking by the inspector.

For light excavation, either on new work or improvements, the surface is generally plowed with teams, and for shallow cuts and short hauls up to 200 ft. it may be removed by wheel scrapers drawn by teams. For greater distances it is generally cheaper to haul the material in dump wagons. For long hauls, where the quantity of earth to be moved warrants it, dump cars on service tracks are usually provided.

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*Division Engineer of first division, Highway Department, New York State, in charge of 12,250 miles of roads in 8,000 square miles of the Hudson River locality.

In new work the plowing is generally started at the summits, the first furrows being made on the ditch lines, and successively continued to the center line of the road.

On heavy work the plows can be hauled by traction engines, one of which will do the work of three teams and do it more rapidly and satisfactorily. On reconstruction work it is frequently desirable to haul a heavy plow by the steam roller, when the latter is not in use for surfacing the finished work.

Where there is a sufficient quantity of excavation in ordinary soil on light grade, it is often done advantageously with special scrapers or graders, the latter often being of the elevating type drawn singly or in pairs by traction engines. Special excavation is usually required for ditches alongside.

In very heavy earth cuts, steam shovels are advantageous and may be operated on traction wheels or on service tracks. They may be fitted with skimmer buckets for very shallow stripping, even including the removal of old pavements only, or they may have ordinary buckets usually of ¾ yd. to 1 yd. capacity. Where the cut is deep enough and conditions are favorable, they are capable of excavating 1,000 yd. or more per day, providing that there is no delay in the removal of the spoil. Usually it is difficult to take away the excavated material as fast as the shovel can operate. This is especially true when it is delivered to horse-drawn wagons. Automobile trucks are more efficient if they can be continuously operated to and from the shovel, and for very large quantities or long distances, dump cars hauled by locomotives are the most efficient. Great care must be taken however to provide the continuous installation, shifting and maintenance of tracks so as to have cars always in attendance and ready for the loaded cars to be immediately side-tracked and promptly hauled away in order to make the operations continuous and uninterrupted.

Usually a good steam shovel will excavate very hard strata, including cemented gravel and some kinds of hardpan and decomposed rock without blasting, but if the strata are very refractory it will pay, even though it can be handled with the extreme effort of the shovel, to shatter it first with light charges of dynamite exploded in holes drilled to subgrade from 5 to 15 ft. apart according to local conditions.

ROCK EXCAVATION.

Rock excavation may be either loose rock and boulders or solid ledge rock. In small quantities it may be drilled by hand, but for amounts of 100 yd or more in one place it is better to use jack-hammer drills operated by steam or by compressed air. On work of considerable magnitude, it would generally pay to install a central power plant from which compressed air is distributed up and down the line for the operation of drills, hoisting engines, concrete mixers, pumps and any other purpose. For small operations there are various types of portable air compressors driven by steam, electricity or gasoline engines.

When much blasting is necessary, a fire-proof, frost-proof, fool-proof magazine should be established at a central point and explosives placed in charge of an expert who will deliver them daily or oftener as required and be responsible for the proper handling and use. (In some cases explosives can be advantageously used for other purposes besides rock work, as in swamps and other places where ditches may often be made entirely by explosives without any hand work except for trimming.) After the rock has been shattered by blasting it can be loaded advantageously by the steam shovels. All blasting should be done by experienced workmen and shots should be fired by an electric machine. Various grades of dynamite are used according to circumstances, but 60 per cent nitro glycerine is usually suitable. About ½ lb. per yard will generally shatter cemented gravel or hardpan sufficiently to enable it to be excavated readily by the steam shovel, and about 1 lb. per yard is generally required for ledge limestone in open cuts, a larger amount being required for granite.

In open cuts it is usually desirable to excavate the rock to the full width and to a depth of at least 10 ft., making successive cuts if the depth is greater. In exposed positions the blast should be protected by rope mattresses or by logs chained together and placed on the surface of the rock before the holes are fired.

Improving New York Subway Service

Public Service Commissioner Lewis Nixon of the First District has issued an order directing the Interborough Rapid Transit Company to make material increases in the service which it renders on all of its subway lines, particularly in the non-rush hours.

The order calls generally for 10-car expresses instead of 8-car and 6-car trains practically throughout the daytime, non-rush hours.

A part of the service increase also covers service in evening, non-rush hours. Some increases are made in rush-hour local service. The tracks are now operated practically to capacity for express service during rush hours, and no material increase is possible during such period.

The service improvements directed by Commissioner Nixon will add to the service being operated in the non-rush hours a total of 600 cars more than are now operated in these hours and 30,000 more seats than are now furnished.

His order follows extensive investigations made by the commission into Interborough service. The commission gave the company until March 10 to determine whether it would accept the order and to March 17 to put the new service into effect.

In Switzerland reliable contractors of established reputation are invited to bid on public work and the contractor whose bid is nearest the average of all bids submitted, receives the contract. If it can be shown that any bid has been juggled, it is rejected and that bidder is not again invited to bid on public work for a specified time.

Annual Paving Statistics

Facts and figures from several hundred cities concerning the amount and nature of work done by each during 1918. (Fifth instalment.)

TABLE NO. 12—LABOR AND CONTRACTING.

City and State	Increase in Cost, Percentage	Common Labor			Kinds of Pavement Laid by Day Labor	Kinds of Pavement Laid by Contract
		Available	Prevailing Price in 1919			
			Per Hour or Day	Hours per Day		
California:						
Chico	...	500	$4.00	8	...	...
Oxnard	33	...	3.75-4.00	9	...	All
Palo Alto	70	Very few	6.00	8	None	None
Pasadena	100	None	3.50	8	...	All
Redlands	...	300	3.25-4.00	9	...	...
San Francisco	...	...	5.00	8	None	All
Santa Barbara	20	600	4.00	8	None	All
Santa Monica	43	Scarcity	4.00	8	None	All
Vallejo	50	50	5.00	8	None	All
Colorado:						
La Pinta	...	...	4.00	10	...	...
Leedville	...	100	3.50	8	...	...
Pueblo	12	...	3.25-4.00	8	...	All
Connecticut:						
Greenwich	50	...	5.00	9	None	All
Hartford	...	...	4.50	...	Concrete and macadam	Sheet asphalt and granite block
New Camden	...	None	5.40	9		None
Stamford	50	...	4	8	By municipality	None
Florida:						
Orlando	60	None	3.00	10	All	None
Idaho:						
Boise	35	...	4	8	None	All
Illinois:						
Mt. Carroll	...	25	4	10	...	...
Winnetka	...	30-35	7	9	...	All
Iowa:						
Atlantic	100	...	5	10	...	All
Centerville	100	...	3.60	9	None	All
Charles City	...	50	5.00	10	...	...
Indianola	...	...	4.00	8	...	...
Sioux City	...	Enough	4.50-5.50	9	None	All
Kansas:						
Parsons	25	Few	3.75	8	None	All
Topeka	100 plus	Not enough	4	8	None	All
Wellington	...	75	4	8	None	None
Kentucky:						
Madisonville	35	300	2.50	9	Cinder, clay, macadam	2-3 macadam
Maryland:						
Hagarstown	100	...	4.00	10	All	None
Massachusetts:						
Cambridge	100	...	4.00	8	All except bithulithic	Bitulithic
Greenfield	...	...	3.50-4.50	8	All	None
Haverhill	50	...	3.75	8	All	None
Lawrence	...	...	4.00	8	Granite block and tar macadam	Bitulithic
Lexington	25	...	3.50	8	All	...
Pittsfield	50	Unknown	4.00	8	Asphaltic macadam	
Winchester	80	Unknown	4.00	8	All	None
Michigan:						
Kalamazoo	75	...	$0.50	9	Municipality	...
Minnesota:						
Duluth	60	...	0.45-0.55	...	Macadam	All other
Northfield	...	Enough	4.00	10	...	...
Missouri:						
Poplar Bluff	25	Very few	0.425	...	All	None
Montana:						
Bozeman	35½	...	4.50	8	None	All
Nebraska:						
Columbus	...	Scarce	4.50	10	...	All
Grand Island	...	...	0.50	9	None	All
Lexington		50	5.00	9	...	All
New Hampshire:						
Nashua	30	150	3.60	8	All	None
New Jersey:						
Irvington	70	...	5.00	9	None	All
Ridgefield Park	Amesite 100	...	5.25	8	None	All
Ridgefield Park	Tarvia X 50	...	5.25	8	None	All
West New York	60	20	5.00	8	None	All
New York:						
Batavia	...	Plenty	3.20	8	...	...
Buffalo	36-68	...	4.50	9	None	All
Corning	...	50	3.20	8	...	...
Depew	Nearly 100	50-100	0.45	...	...	All
Gloversville	90-100	Very few	3.60-4.00	9	None	All
Bronx, N. Y. City	...	...	4.50	8	None	All
Man., N. Y. City	Asphalt 92 Granite 58 Wood 60	...	4.00-4.25	8	None	All

TABLE NO. 12—LABOR AND CONTRACTING—(Continued).

City and State	Increase in Cost, Percentage	Common Labor			Kinds of Pavement Laid by Day Labor	Kinds of Pavement Laid by Contract
		Available	Prevailing Price in 1919			
			Per Hour or Day	Hours per Day		
New York:						
Rich., N. Y. City	100-250	...	5.00	8	None	All
N. Tonawanda..	71	...	0.50	10	...	Bitulithic
Oneonta	100	...	3.60	8	...	All
Port Jervis.....	...	...	...	...	All	None
Syracuse	70	1000	4.00	8	None	All
Troy	...	...	4.00	19	All	None
Waverly	90	None	3.50	10	All	None
North Dakota:						
Bismark	90	Very few	5.00	10	None	All
Minot	33⅓	300	5.00	10	...	All
Ohio:						
London	65	...	4.00	8	None	All
Oklahoma:						
Enid	20	100	4.40	8	None	All
Oregon:						
Ashland	...	...	4.50	8	...	...
Eugene	70	Plenty	4.50-5.00	8	None	All
Pennsylvania:						
Athens	90	None	3.50	10	None	All
Bridgeport	...	Scarce	4.80	8	...	...
Butler	55	...	3.60	9	Resurfacing	New work
Duquesue	50-52	Uncertain	5.00	9	None	All
Johnstown	115	No surplus	4.50	9	None	All
Mechanicsburg..	30	Very few	2.75	10	All except brick	Brick
Pottsville	...	...	3.00	8	...	...
Rhode Island:						
Providence	...	...	...	...	Granite block and macadam	Sheet asphalt
South Carolina:						
Columbia	100	Unknown	3.00	10	None	All
Tennessee:						
Harriman	...	...	2.50	10	None	All
Texas:						
Brownwood	...	None	3.50-4.00	8	...	...
Port Arthur ...	33⅓	...	3.50	8	Gravel top shell	None
Temple	50	200	3.00	8	Brick	...
Utah:						
Salt Lake City..	50	Sufficient	4.00	8	None	All
Vermont:						
Burlington	About 100	500	3.25	9	All	None
Virginia:						
Newport News..	...	Very few	4.00-4-50	10	...	Concrete
Washington:						
Chehalis	...	50	5.00	8	None	All
Dayton	100	Few	5.00-8.00	8	...	All
Port Townsend.	...	...	4.00-4.50	8	...	...
Raymond	70	100	5.50	8	Replanking	Concrete
Seattle	50	...	5.50	8	9,740 yd. concrete	All remainder
Spokane	62	4,000	4.50	8	None	All
Walla Walla	65	Enough	5.00	8	None	All
Waterville	20	...	5.00	8	None	Gravel
Winlock	100	None	4.50	8	...	All
West Virginia:						
Fairmount	80	300	0.50-0.55	8	None	All
Huntington	115	...	4.00	10	...	All
Moundsville ...	100	Scarce	3.00-4.00	9	None	All
Wisconsin:						
Wausau	33	...	4.25	10	Tar macadam	Brick
Wyoming:						
Sheridan	50-100	...	4.00-7.00	10	None	All

Table No. 8—Tar or Asphalt Macadam Laid in City Streets During 1919.

City and State.	Yards or miles laid	Av. Cost sq. yd.	Thickness inches	Gallons, per sq. yd.
California:				
Redlands	....	...	5	1¼
Santa Barbara	2,700	$0.45	2	½
Connecticut:				
Greenwich ...	14,000	1.79	3	2½
Stamford	1¼	1.00	3½	2¼
Massachusetts:				
Greenfield ...	3,984	1.125	6	2
Haverville ..	2,890	1.67	2¼	2
Lawrence	86,746	1.15	3 stone	1½-1¼a
Lexington ...	6,816	0.90	4-5	2.2
Pittsfield	200	...	..	2
Winchester ..	5,800	0.85	..	1½
New Jersey:				
Ridgefield Park	19,000	1.70	6	2¼
New York:				
Richmond Borough, N. Y. City	3,006	2.00	6½	2
Oneonta	11,000	1.85	7	1.75-2.25
Rhode Island:				
Providence ..	12,227	...	3	2¼
Tennessee:				
Harriman	3,750	0.80	..	2½
Vermont:				
Burlington ...	8,500	1.00	3	2
Wisconsin:				
Wausau	4,000	...	8	..

a—Binder 1½ and sealed coat 1¼ gal. Tarvia. Work done by day labor. Does not include grading or other work.

Tension Splice for Timber

A new splice for wooden tension members that has been designed by S. Murray, chief engineer of the Oregon-Washington Railroad & Navigation Co., is intended to provide high efficiency, a shrinkage adjustment and to prevent decay.

A pair of cast iron plates gained into the surface, are securely bolted to opposite sides of each timber near the splice. They are provided with outstanding flanges having reinforced bearings for pairs of screw rods proportioned to take the full tensile strength of the next section of timber and are adjustable to compensate for any shrinkage. For a 10 x 12-inch timber the 12-inch plates are located 18 inch clear of the joints and are connected by four 1⅜-inch round rods.

Leadville, Colorado, in 1919 laid a half-mile of gravel by volunteer labor aided only by the city truck. The gravel was taken from a neighboring mine dump, the mine owners making no charge for it. It was spread on the road to a depth of about six inches and was packed down by traffic,

United States Civil Service Examinations

An examination will be held on April 6, 1920, for the position of assistant fuel engineer for the Bureau of Mines, Department of the Interior at Pittsburg, Pa., at a salary of $4,200 a year. Applicants must be graduates in mechanical engineering from a college or university of recognized standing and have had at least one year's experience in work dealing largely with fuel engineering and the management of boilers and furnaces. Apply for Form 2118.

An examination will be held April 13, 1920, for assistant specification engineer for vacancies in the office of the Chief Signal Officer, War Department, Washington, D. C., at $1,200 to $2,000 per year. Apply for Form 2118.

An examination will be held April 13, 1920, for junior mechanical engineer for a vacancy at the National Advisory Committee for aeronautics, Langley Field, Virginia, at $1,800 a year. Apply for Form 1312.

An examination will be held April 13, 1920, for fuel research assistant for vacancies in the Bureau of Mines, Department of the Interior, throughout the United States, at a salary of $1,200 to $1,800 a year. Apply for Form 2118.

In all the above cases, both men and women, if qualified, may enter the examinations, but appointing officers have the legal right to specify the sex desired in requesting certification of eligibles. Positions requiring similar qualifications at these or higher or lower salaries will be filled from these examinations unless it is found to be in the interest of the service to fill vacancies by reinstatement, transfer or promotion. All applicants should immediately apply for the application forms required, stating the title of the examination desired, to the Civil Service Commission at Washington, D. C., Secretary of the U. S. Civil Service Board, Custom House, Boston, Mass., New York, New Orleans, Philadelphia, Atlanta, Cincinnati, Chicago, St. Paul, Seattle, San Francisco, St. Louis.

80-Foot Concrete Flag Pole Cast Vertical

At Ancon, in the Panama Canal Zone, an 80-foot reinforced concrete flag pole 17 inches in diameter at the base and 8½-inches at the top was successfully cast in place in vertical position to avoid the difficulty and strains that would have been involved in revolving it from horizontal to vertical.

A pit 10 feet deep was dug to receive the base of the pole and concentric with it there was erected a wooden falsework tower more than 70 feet high above the surface of the ground. The tower was made of the usual hoist tower type with four corner posts braced by horizontal and diagonal members on every side, and the base of the tower was braced by pairs of inclined struts connected to the corner posts 10 or 15 feet above the ground.

The 8 reinforcement bars diminishing in size from the base to the top were assembled full length in position and stayed there while the wooden forms made in longitudinal halves in sections 8½ feet long were assembled and concreted at the rate of about 1 section per day, great pains being taken to do the work accurately and to plum the forms by means of two transits.

Concreting an Old Highway Bridge Floor

A steel truss highway bridge of 56 feet span with a roadway 14 feet wide, carries the Staunton-Parkersburg Pike across Mill Run, near Parkersburg, West Virginia. It needed a new floor when the engineers, Woodyard & Alexander, were preparing to pave the Pike with concrete in 1916, and rather than continue the expense of flooring it periodically with planking it was decided to carry the pavement right across it. Accordingly the grade of the road was fixed at 10 inches above the tops of the floorbeams, 4 inches above the tops of the 6-inch I beam stringers that rest on the top flanges of the 15-inch I-beam floorbeams.

When the paving mixer came to the bridge it was run up on heavy planks laid on the old floor and the pavement was completed to the abutments of the bridge. Then the flooring in front of the mixer was quickly removed and a section of false floor was slung into place under the stringers. The reinforcing, ¾-inch twisted bars, was laid 8 inches apart in both directions and wired together on top of the stringers, sagging down between them.

The concrete was placed just as though the floor was a portion of the road, and when a section was poured the mixer was moved along and another section treated in the same way, until the slab was completed for the entire length of the bridge. The stringers are encased with concrete except their lower flanges. From the time the first flooring was removed until the last concrete was poured, was two hours and twenty-eight minutes.

Laying a Mountain Pipe Line

In laying a 12-foot pipe line in the Adirondacks, a public service corporation used a small movable derrick mounted on a portion of the pipe already built, and operated by an electric hoisting engine and hand crab. The pipe was of 9/16 to 11/16-inch steel plates, in sections 7½ feet long. Five complete rings could be erected at one setting of the derrick, which erected as many as three rings in a 9-hour day.

The derrick had one stiffleg resting on the pipe and was side-guyed to adjacent trees with light wire rope tackles. The foot block was bolted through open holes in one of the pipe seams, and at the foot of the stiffleg there was a heavy bent strap with a number of connection bolt holes in the horizontal leg. The mast was adjusted vertically on the various grades encountered by bolting through the proper holes in the strap to the open holes of one of the seams back of the stiffleg.

Hall county, Nebr., expended about $6,000 on the purchase of a traction machine, two graders, seven dump wagons and four scrapers that were used on the construction of 32 miles of State and Federal Aid highways during 1918. In 1919 the equipment was supplemented by about $5,000 worth of new plant and the 1918 cost of 30c a yard for grading was reduced last year in one case to about 21c, and in another case to about 12c. The gravel surface was contracted for at cost plus 15 per cent.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

CONTRACTOR NOT EXCUSED BY MISLEADING SPECIFICATIONS.

RE:—CHARLES H. SEMPER vs. DUFFY, State Commissioner of Highways. New York Court of Appeals, Oct. 14, 1919. A bidder for state highway construction who agreed in his itemized proposal for the work that his accompanying certified check should belong to the state if he failed to execute the contract; that his information regarding materials "was secured by personal investigation and research and not from the estimates of the state," and who thereafter refused to execute the contract on the ground that the state's estimate sheet mistakenly indicated that stone for the job could be had at a certain place and for a certain price, is not entitled to a return of his certified check.

Pound, J—Relator was a bidder for the construction of a state highway. The estimate sheet exhibited by the state commission of highways to contractors indicated in entire good faith that the supply of stone necessary therefore could be obtained at Union Springs at 90 cents the cubic yard. That was a mistake, as relator discovered after making his bid. It could only be obtained elsewhere at a much higher cost. He refused to execute the contract and now seeks to recover a certified check for $1,450 which he deposited with his proposal, to become the property of the state if his proposal was accepted and he failed to execute the contract. It has been held below that his proposal was due to a misunderstanding on his part or a mutual mistake of fact as to the possibility of obtaining the stone at Union Springs according to the estimate and that it was the clear legal duty of defendant to return the check.

I reach the conclusion that no mistake or misunderstanding as to the place where the relator could obtain stone will avail him in his proceeding. His itemized proposal states that he has carefully examined, among other things, "the form of contract," and that the certified check accompanying the bid "shall become the property of the state if his proposal is accepted and he fails to execute the contract." He thus binds himself to enter into a contract in and by which he agrees that his information "regarding all the conditions affecting the work to be done and labor and materials to be furnished for the completion of this contract was secured by personal investigation and research and not from the estimates of the state commissioner of highways; and that he will make no claim against the state by reason of estimates, tests or representations of any officer or agent of the state." It thus appears that the proposal was so related to the contract that the contractor was precluded from relying on the statement in the estimate that stone would be obtained at a given place at a given price. The statement was suggestive merely, directing him for inquiries to what the state considered the nearest available source of supply. The bidder had the same opportunity to discover the facts that the state had, and he in his proposal agreed to execute a contract to the effect that he had availed himself of his opportunity and was content to make the proposal and to execute the contract upon the understanding that he was relying on his own personal investigation.

We held in Faber vs. City of New York (222 N .Y., 255, 260) that where the contractor had no reasonable opportunity to discover the truth as to the position of bed rock, and the evidence was sufficient to show that the bed rock was as indicated in the plan prepared by the city, the contractor might recover for extra work, but here the parties had an entire equality of opportunity. The case is the same as any mutual misunderstanding as to price, source of supply and the like. The proposal is made at the bidder's risk in these regards, certainly where no element of deception or inequality or inequity is presented. The bidder has forfeited the money accompanying his bid by failing to execute the contract. The result may seem harsh, but the state properly protects itself by the strictness of its contract, and the relator must be bound by the terms thereof as proffered.

The orders of the Special Term and the Appellate Division should be reversed, and the application for the writ of mandamus denied, with costs to appellant in all courts.

Hiscock, Ch. J.; Chase, Cardozo and Andrews, J. J. concur;

Hogan, J., absent; McLaughlin, J., not voting.

Orders reversed, etc.

SURETY BONDS FOR FAITHFUL SERVICE DOES NOT COVER PRESENT CLAIMS.

In Village of Argyle *vs.* Plunkett, 124 N. W. R., Page 1, the Court of Appeals of New York held that where a bond was conditioned merely for the faithful performance of the contract and contained no obligation of suretyship for the payment by the contractor of his debts incurred in the work the surety company was not liable to the village because of the contractor's failure to pay for labor and material. The Court pointed out that the village had no personal interest in the unpaid claims, that it had not paid any of them, and that it was not personaly liable for their payment, that the liens filed were simply against any underpaid balance on the contract.

The judgment of the Appellate Division, which had affirmed a judgment for the plaintiff, was reversed and the complaint dismissed.

RESPONSIBILITY FOR LIVE WIRES.

RE:—SWACZYK vs. DETROIT EDISON COMPANY. Supreme Court of Michigan, Oct. 6, 1919. P. 197 NWR 174. A charge, in an action by the administrator of a small boy, who died as a result of coming in contact with a live wire, that, if anybody is furnishing electricity as furnished by the defendant, a very high degree of care is enjoined, perhaps the highest degree of care which is reasonably practical, held, correct not imposing an undue standard on defendant, but merely requiring reasonable care under the circumstances, considering the hazards of the business.

NEWS OF THE SOCIETIES

March 15.—RAILROAD CONFERENCE. Second annual conference will be held at Congress Hotel, Chicago, auspices of American Association of Engineers, 63 East Adams street, Chicago.

March 16-18. — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Manhattan Building, Chicago.

March 24-25. NATIONAL WHOLESALE LUMBER DEALERS ASSOCIATION, Washington, D. C. Secretary, 66 Broadway, New York.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

March 24-26. SOCIETY OF INDUSTRIAL ENGINEERS, Bellevue-Stratford Hotel, Philadelphia. Secretary, 327 South La Salle St., Chicago.

March 25. NORTH CAROLINA PINE ASSOCIATION, Norfolk, Va. Secretary, Norfolk, Va.

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

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Indiana Sanitary Water Supply Association.

At the 13th annual meeting, held at French Lick, Ind., March 8 and 9, the program included address by President John W. Toyne; report of Committee on Water Workers Devices and Machinery; Round Table Discussion. Water Meters, Service and Repairs, led by Dow R. Gwinn, Charles Winkle; Rebuilding Water Works Power Plants, Charles Brossman; Service Control by the Indiana Public Service Commission, M. D. Atwater; Growth of Water System at Gary, Ind., W. S. Luscombe; Pitometer Survey of the Evansville Water System, Charles Streithof; The National Board of Fire Underwriters' Method of Rating Cities on Fire Service, Clarence H. Goldsmith; Round Table Discussion—Reduction of Fire Loss in American Cities, led by William J. Curran, Superintendent of Indianapolis Salvage Corps, Indianapolis, Ind.; Supervision of Water Filtration in the State of Ohio, F. Holman Waring; Sewage Disposal in Indiana, J. B. Marvin; Progress in Construction of Indianapolis Sewage Disposal System, Jay A. Craven; Advantages of an Association of Public Utilities, J. N. Wells; Round Table Discussion—Present Limitations of Financing Public Utilities, led by E. L. Loomis, Dow R. Gwinn, Howard W. Painter; Water Service of the American Troops in France, Edward Bartow; The Production of Bottled Mineral Waters, L. R. Taylor; Sanitary Improvements in Indiana, M. V. Ziegler, discussion led by Robert E. Tracy; The Post-War Duties of the U. S. Public Health Service, Dr. L. L. Lumsden, surgeon, U. S. Public Health Service; Co-operation Between the Health Officer and the Water Works Superintendent, Dr. Hugh A. Cowing, president Indiana State Board of Health, Muncie Ind.; discussion led by Dr. W. F. King, Assistant State Health Commissioner, Indianapolis, Ind. Odors and Tastes in the Danville Water Supply, Edward Bartow; Fifteen Years' Operation of Slow Sand Fillers at Indianapolis, H. E. Jordan; report of Committee on Water Purification, W. H. Durbin.

Railroad Engineers' Conference.

At least 50 per cent. of the 52 railroad sections of the American Association of Engineers will send delegates to the second annual railroad conference to be held in the Congress Hotel, Chicago, on March 15. The total membership of the railroad sections of the association is in excess of four thousand. The seven largest sections in point of membership are the Pennsylvania, the New York Central, the Chicago, Burlington and Quincy, the Southern, the Baltimore and Ohio, the Chicago and Northwestern and the Illinois Central. Among the speakers and subjects are:

"Plans for A. A. E.'s Future Railroad Work," by G. W. Hand, chief engineer of the Northwestern Railway. Discussion by J. B. Jenkins, valuation engineer of the Baltimore and Ohio, and F. E. Morrow, chief engineer of the Chicago and Western Indiana.

"A. A. E. Railroad Salary Schedule," by W. C. Bolin, of the association railroad committee. Discussion by R. W. Barnes, principal assistant engineer of the Southern Pacific; C. F. Bowler, president of the Burlington Lines East Railroad Section; A. M. Knowles, president of the Erie Railroad Section; O. R. West, president of the Santa Fe Coast Lines Section.

"Railroad Sections—Their Organization and Function." The speaker is not selected.

"Railroad Sections—Their Relation to the Railroad Management," by F. C. Huffman, president of the Chicago and Northwestern Railroad Section.

"Railroad Sections—Their Relation to the Chapters," by Paul Augustinus, past president of the Chicago Chapter.

These subjects will be presented at the afternoon session, of which J. R. Leighty, chief engineer of the Missouri Pacific, will be chairman. The morning session, which will be in charge of W. W. K. Sparrow, assistant chief engineer of the Milwaukee, will be devoted to registration, reports and a resume of the accomplishments of the association in railroad work during 1919 by D. A. Tomlinson.

At the evening session, at which W. H. Hoyt, chief engineer of the Duluth, Missabe and Northern Railroad, will preside, Dr. F. H. Newell, president of the association, will speak on the "American Association of Engineers—Its Aims and Ideals." Other speakers at the evening session will be Arthur S. Tuttle, chairman; Bion J. Arnold and Oscar C. Merrill, members of a committee to represent Engineering Council.

S. M. Felton, president of the Chicago Great Western Railroad, will speak on "Problems of the Railroads Since Their Return to Private Control."

Engineers' Architects and Constructors' Conference on National Public Works.

This conference is a federation of engineering societies. The term "Engineering" is here used in the broadest sense to include:

1. Professional engineers and architects.
2. Technical men, such as geologists, physicists, chemists and research engineers.
3. Builders and constructors.
4. Operators of engineering enterprises and properties.
5. Producers of raw material used in engineering works.
6. Manufacturers and merchants of engineering plant and equipment.
7. Allied business associations.

There were represented at the formation of the conference in Chicago, April 23-25, 74 technical societies with a membership of 105,000.

The conference seeks to educate the people concerning the need of consolidating the vast public enterprises of the nation under one central department, which would be known as the Department of Public Works.

The conference has appointed an Executive Committee, whose headquarters are in the McLachlen Building, 10th and G streets, Washington, D. C., and has had prepared and introduced into Congress the "Jones-Reavis" bill, creating a national Department of Public Works. This bill, Senate No. 2232, House No. 6649, was introduced on June 25 by Senator Jones, of Washington, and Mr. Reavis, of Nebraska.

The Third Nebraska Road Institute.

The purpose of the Nebraska Road Institute is to aid in supplying information to highway commissioners and engineers relating to the construction and maintenance of Nebraska's roads. It is hoped that this institute will be instrumental in bringing together for open discussion, commissioners and engineers, and that each will be made to see more clearly the duties assigned him and as a result attempt to execute them harmoniously and efficiently. The lectures and papers will be presented by highway engineers and commissioners who are specialists in their line; men of broadest experience and widest reputation. They have been selected because of their ability to handle the subject assigned to them. The list includes, aside from the special lectures from other states, engineers from the Nebraska Department of Public Works and members of the faculty of the University of Nebraska.

The American Association of Engineers.

The Philadelphia Chapter has elected the following officers for 1920: President—Edmund J. Fitzmaurice, of the firm of Ballinger and Perrott, architects and engineers; first vice-president—J. J. Crowe; second vice-president—Jos. Chapin; third vice-president—E. E. Keller;

recording secretary—H. H. Cramer; treasurer—Jesse R. Henderson; executive secretary—H. F. Kuzen.

The following officers have been elected for 1920 by the Ogden, Utah Chapter: President—W. F. Turner; vice-president—H. J. Craven; secretary—E. H. Kidder; assistant secretary—B. W. Matteson; treasurer—W. S. Craven.

The Swarthmore College Engineers' Club voted on February 11 to affiliate with the American Association of Engineers as a student chapter. At present there are about twenty-five or thirty members and it is expected that this membership will be increased to eighty soon. Edmund P. Smith is president; Howard Jenkins is vice-president, and Edmund E. Bartleson, secretary and treasurer. The club was founded about 1914 to promote the interests of students in engineering.

A large and successful local meeting was held by the Milwaukee Chapter of the American Association of Engineers on February 24. The triple attraction of a meeting advocating ethical organizations of engineers as opposed to unions, Isham Randolph, eminent consulting engineer of Chicago, and Secretary C. E. Drayer of the American Association of Engineers resulted in an attendance of 700 or more engineers of Milwaukee, Racine and Kenosha.

Organization of engineers for the promotion of their economic interests was advocated by Doctor Randolph, who deprecated the tendency of some of the embryo engineers to become affiliated with union organizations. Mr. Drayer pointed out the splendid results that have been accomplished by the American Association of Engineers. He outlined the work of the service department, of the railroad department which has obtained substantial increases for a great majority of the railroad professional engineers of the United States, and touched upon the other activities of the association.

The Ohio State Assembly, composed of the eight chapters and two clubs of the association in that state, adopted a constitution at its second meeting in Columbus on Feb. 28.

The following officers were elected: C. R. Rood of Toledo, president; J. E. Root of Akron, first vice-president; E. K. Ruth of Cincinnati, second vice-president, and W. L. Mattoon of Columbus, secretary-treasurer.

The Cambridge, O., Club held a banquet and meeting on February 25. Among the speakers were Francis E. Sheehan, superintendent of the Cambridge Filter Plant; E. C. Murray, general superintendent of the National Coal Company; W. A. Faucett, division engineer of the State Highway Department; A. R. McCulloch, chairman of the advisory board of the State Highway Department; District Secretary F. E. N. Thatcher of Pittsburgh; and H. J. Shaw, division engineer of the Marietta division of the Pennsylvania Railroad.

The Trenton, N. J., Club was organized on February 20 at the Trenton Engineers' Club. Officers were elected as follows: President, H. D. Robbins, division eningeer, State Highway Department; secretary R. R. Pope, resident engineer, State Highway Department; and treasurer A. G. Nicolaysen, State Board of Taxes and Assessments.

Resolutions were adopted urging Congress to support and make effective the reclassification recommended by the Keating Commission, asking the Senate conferees on the Water Power Bill to recede from the Senate amendment providing that the secretary of the Water Power Commission be an army engineer and encouraging the House conferees to stand behind the original provisions of the bill, and urging the Congressional committees considering the Jones-Reavis Bill, providing for a national department of public works to approve the bill.

The Bismarck, N. D., Chapter was organized on February 20 with J. E. Kaulfuss, assistant chief engineer of the North Dakota Highway Commission, president; B. H. Long, vice-president; G. F. Ludvigsen, assistant engineer, North Dakota Highway Commission, secretary; W. T. Stratton, consulting engineer, North Dakota Railroad Commission, treasurer. The usual committees were appointed, including one on licensing.

The Albany, N. Y., Chapter of the A. A. E. has elected O. F. Rowland, president; R. N. Barrett, secretary; and R. E. Harman, treasurer. Six vice-presidents were elected.

The first action of the chapter after organizations was a resolution supporting the Jones-Reavis Bill which is to be forwarded to the representatives of the chapter in Congress. The membership of the chapter increased 25 per cent. within eighteen hours after the meeting.

North Dakota Society of Engineers.

At the 12th Annual Convention, Grand Forks, N. D., March 10 and 11, the program included the address of welcome by Mayor H. M. Wheeler, response in behalf of Society, and president's address, by J. A. Jardine. Preliminary reports of committees on possible affiliation with American Association of Engineers, Municipal Improvements, Highways and Bridges, Architectural Engineering, Electrical Development, Fuel, Clay Products and Brick, Field Survey Methods, Drainage, Legislation Standardized Fees, and Per Diem for Engineering Services.

Papers were presented on the New Water and Sewer System Regulations of the State Board of Health, by I. W. Mandelsohn, The Proposed National Department of Public Works, by D. R. Jenkins, Operation and Maintenance of Utilities in the Army Cantonments, by F. L. Anders, Sanitary Work in Epidemics, by Samuel Claman, Concrete Aggregates in North Dakota, by A. G. Leonard, The Relation of Architects to Engineering Work, discussed by several architects and engineers. Increased Costs of Material used by Public Utility Companies, by C. A. Thompson, and Present Status of Irrigation in North Dakota, by J. M. Hansen.

There was a Good Roads Dinner, under auspices of Good Roads Committee of Commercial Club, County and State Highway Officials and Society Members to consider roads, and federal highway plans and policies, and inspection trips were made to the new plant of the Northern Packing Company and other places.

The Northwestern Association of General Contractors.

The annual convention was held in Minneapolis, February 23. Ralph Budd, president of the Great Northern railway gave an address on railroads; C. M. Babcock, commissioner of highways, talked on highways; Royal A. Stone, of St. Paul, discussed Contracts, and John H. Rich, president of the Federal Reserve Bank, spoke on The Financial Situation. A banquet followed.

American Concrete Pipe Association.

The annual convention was held in Chicago, February 20 and 21. Following officers were elected for the coming year: President, A. N. Shearman, Knoxville, Tenn.; vice-presidents: Ernest Bent, Los Angeles, Calif.; Harry K. Cain, Mankato, Minn., and A. M. Hirsh, New York City. Executive Committee: C. F. Buente, Pittsburgh, Pa.; W. A. Curless, New York Ciy; J. J. Hammen, Spencer, Iowa; Arthur McHose, Boone, Iowa; J. E. Moody, Chicago; J. L. Zeidler, St. Joseph, Mo.; W. J McCracken, Luverne, Minn; W. E. Goodman, Saginaw, Mich., and F. J. Lawson, Oxford, Ind. Manager, G. E. Warren, 210 So. La Salle street, Chicago. Association membership has increased and new office in Chicago will be opened.

NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

United Iron Works Co.

This company manufactures non-vibrating, double stroke, deep well power pumps listed in six sizes having cylinders 3 to 24 inches diameter, 70 to 110 inches long that are operated at 33 to 10 R. P. M. according as the depth below the surface of the location of the cylinder varies from a minimum of 50 to a maximum of 800 feet. They have capacities, under these heads varying from 30 to about 2,200 gallons per minute. They are recommended for reliability of service, durability, and efficiency. They are suitable for municipal and public service waterworks plant, tunnel draining, shaft sinking, railroad water supply, boiler feed, irrigation, drainage, and fire protection.

They are designed to be operated with any kind of power and are fitted with plain or friction clutch pulleys, gears, pockets or other transmission devices. The power head is placed at the top of the well, shaft or pit and the cylinder or working part, is placed below water level in the well. The plungers may be removed for repacking without withdrawing them through the top of the column pipe which can be placed in the corner of the shaft. The column of water passing through the cylinder never comes to rest while pumping is maintained and the duplex system with long overlapping strokes gives an uninterrupted movement of the column of the water and a continuous discharge.

Morris Knowles, Inc., Seventh Annual Dinner.

About 80 officials and employees of the organization of Morris Knowles, Inc., prominent engineers of Pittsburgh, Pa., assembled Feb. 14 in the banquet hall of the University Club. Toastmaster Joseph Henry White called upon Morris Knowles, president and chief engineer of the organization, who made brief mention of the earlier times when the first dinner of the organization was held in 1914 with ten present. Mr. Knowles announced final arrangements for the consolidation of the organization of Morris Knowles, Inc., with that of the late R. Winthrop Pratt, of Cleveland. The Cleveland office will continue to be operated, but under the name of Morris Knowles, Inc., and will be under the direct supervision of R. F. McDowell and R. E. Garvin, who were continuously associated with Mr. Pratt up until the time of his death. The various branch offices established by each organization will be continued with the possibility of others being added.

Although both offices have done important work in connection with water supplies and water purification projects, sewerage systems and drainage, Mr. Pratt's organization has had especially helpful experience in garbage and sewage disposal plants, sewerage systems and waterworks, while Morris Knowles, Inc., has developed strong departments of town planning, industrial housing, flood prevention, valuation and rate making, and appraisals. This consolidation results in a personnel of 130 and places the organization of Morris Knowles, Inc., among the largest engineering firms of the United States and Canada.

Blaw Single Line Buckets.

Blaw single line buckets may be operated with a single hoisting drum and may be hooked on the block of any crane, derrick, or other hoist as easily as a sling, requiring no changes whatever in the lines nor in the machinery to make the rig ready for clamshell bucket work.

When the bucket work is finished, the closing line yoke is slipped off the block hook, leaving the rig free for other service.

Blaw single line buckets are also frequently reeved direct to the hoisting drum.

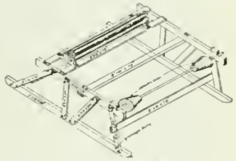
There are no locks, catches, nor other sliding parts in the Blaw single line bucket. The locking effect is obtained simply and effectivly by the position of the folding arms carrying the lower block. Dumping of the load can be accomplished either automatically (by relieving tension on hoisting line), by hoisting the bucket against a fixed stop, or by pulling on a hand line attached to a tripping lever, which line may serve also as a tag line.

Either standard carriage type or Blaw automatic single rope type cableways can be readily equipped for clamshell bucket operation by replacing the fall block with a Blaw single line bucket with tail sheave. No additional lines or changes in the hoist are needed.

These buckets are kept in stock in standard sizes of capacities of 12.75 to 43 cu. ft., water level, corresponding to 18 to 86 cu. ft., heaped, as for ashes and other loose, light materials.

Pavement and Curb Reinforcement.

National road fabric, handled by the H. H. Robertson Co., is an electrically welded wire fabric for concrete road reinforcement. It has no rough or sharp edges, the mesh varies to suit requirements and is heavily galvanized. It is furnished in flat sheet bundles or in rolls from 200 to 400 feet long. It is made in 16 standard styles with 4x8 and 4x12 mesh with wires of 7 to 11 gage, a sectional area of 0.043 per square inch and a weight of 20.0 to 34.8 per 100 square feet.



FABRIC STRAIGHTENING DEVICE ON SLED.

A set of rollers provided with a conical idler guide to keep the fabric in line is mounted on a sled and can be furnished for conveniently straightening the rolled fabric.

The National curb reinforcement consists of a light steel bar, curved in cross sections to make a fillet protecting the rounded upper corner of the curb, and anchored to the concrete by bent strips projecting into it that are sheared from each edge of the fillet, except for a short length, where they are integral with it. It is heavily galvanized after fabrication and is sold in stock lengths of 10 feet, bent if required to any radius.

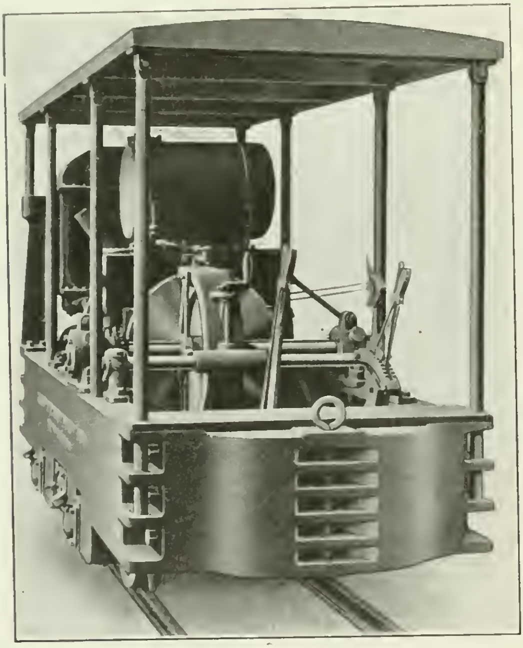
The Asphalt Association.

Brochures No. 5, 6, 7, 8, 9, 10, and 11, recently issued by this association are convenient and attractive and contain information concerning terms used in connection with asphalt for highway work, asphalt macadam, asphalt fillers, sheet asphalt, asphaltic concrete, and asphalt paving mixtures, all of which are intended to be of practical sevrice to designers, officials and contractors.

A Correction.

Some of the principal features of the Burton Gasoline Locomotive were described in Public Works, Feb. 21, page 127, where it was erroneously stated that the fuel consumption, either gasoline or kerosene, was from 5 to 10 gallons an hour, when the consumption should have been stated as at the rate of 5 gallons in 10 hours. The locomotive is operated by a Herschell Stillman motor with four 3½-inch cylinders with 5-inch stroke, drop forged crank shaft, double heat treated bearings, helical type timing gears, thermo-syphon cooling, and lubrication force feed by pumps, to crank shafts, cam shafts and pump shaft bearings and splash to upper and lower rod bearings and cylinders. It is rated at 25 h.p. for 1,000 r.p.m. and 41 h.p. for 2,000 r.p.m.

The drive wheels are operated by steel roller chains and cast steel sprockets of extra size. The locomotive is equipped with special sand boxes heated by engine exhaust and sanders operated by foot pedals providing for a start under heavy loads with adverse track conditions. The cab extends the full length of the locomotive giving comfortable room for the operator and free access to all parts. The designers have aimed at a high degree of simplicity and accessibility.



FRONT VIEW OF GASOLINE LOCOMOTIVE.

Clark Truck Tractors.

These machines although designed largely for service in factories have many uses for general construction requirements such for instance as distributing concrete from a mixing machine to the forms. They are essentially small, simple, gasoline power trucks of very rugged construction with a 25 h. p. 4-cylinder engine, internal gear drive axle with enclosed drive gears, steel wheels with roller bearings and solid rubber tires. They have a 78-inch wheel base, ground clearance of 9½ inch, over-all height of 62 inches, maximum load capacity of 2,500 pounds, weigh 2,450 pounds and have a speed of ½ mile to 12 miles per hour. When fitted with a tilting body or bucket they are very convenient for transporting wet concrete and can be used to advantage for country road paving for a distance, it is claimed, of 2 miles. These same truck tractors can bring back loads of cement and aggregate to the mixing machine. They are of simple design with rear wheel gear, low center of gravity, large ground clearance, flexibility of control and low upkeep and operating costs.

PERSONALS.

Mumm, Hanz, Jr., who has recently been county engineer of Snohomish Co., and city engineer of Everett, Washington, has joined the staff of the Portland Cement Association in 1916 and has just been put in charge of a new association office at 1406 5th St., Portland, Ore.

Evans, Kenneth, has been promoted from assistant construction engineer, Division of Highways, Illinois Department of Public Works and Buildings.

Hyde, Dorsey W., Jr., has resigned as librarian of the New York Municipal Reference Library to accept a position as chief of the Motor Truck Research Bureau of the Packard Motor Car Company, of Detroit, Mich. The bureau will be a new development of the company's service, aiming at the collection and classification of all data pertaining to transportation problems and their solution.

Rankin, Miss Rebecca B., who has served as assistant librarian during the past year, has been appointed librarian of the New York Municipal Library. Miss Rankin is a graduate of the University of Michigan and of Simmons School of Library Science, and has served previously as librarian of the Washington State Normal School and as assistant to the director of the New York Public Library.

Goldsmith, William, has resigned his position as construction engineer with the City of New York to become president and general manager of the Riverdale Construction Co., Inc., at 1440 Broadway, New York City.

Carruthers, W. S., division engineer, Division 3 California State Highway Commission has received a year's leave of absence to act as engineer of Sacramento Co., Calif. ed engineer of Jackson Co., W. Va.

Lupfer, Edward P., has been appointed member of the Buffalo Public Bridge Commission to investigate proposed international bridge across the Niagara river.

Webster, George S., has been appointed chief engineer Bureau of Surveys, Department of Public Works, Philadelphia, a position he held many years before accepting that of Director of the Department of Wharves, Docks and Ferries which he is now vacating.

Morse, E. K., opposed the street car loop project originated by E. V. Babcock, of Pittsburgh, and has been removed by the latter from his position as Transit Commissioner of Pittsburgh.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, MARCH 20, 1920 No. 10

Hetch Hetchy Water Supply* II

Early Intake power station provides 4,000 hydro-electric horsepower for construction operations at an initial cost of nearly $690,000, exclusive of transmission line and operation. The $283,000 concrete dam, 70 feet high, contains over 11,000 yards of concrete, distributed by a combination of cable cars and spouting system. The aqueduct canal, 1 mile long, was concreted from an overhead traveling platform. About 1½ miles of temporary wooden flume, with a minimum section of 5 x 6½ feet, contain 1,300,000 feet of lumber, and will ultimately be replaced by rock tunnels. A mile of rock tunnels have already been driven for the present service. The three large turbines are each supplied by a 42-inch steel penstock under 345.5 head, secured by heavy concrete anchorage foundations.

Supplementary to the construction of the main storage dam and aqueduct at a cost of $45,000,000 for the delivery to San Francisco of an immediate supply of probably 600,000,000 gallons of water per day from a watershed 150 miles distant in the Sierra Nevada mountains, there was established a preliminary hydro-electric power plant at a critical point on the line of the aqueduct to supply a large amount of power for construction purposes.

CONSTRUCTING 44-FOOT SPAN INCLINED CONCRETE ARCHES OF ELEANOR DAM.

The power station, located at the east end of the main tunnel at the point marked Early Intake on the topographical sketch published in the Municipal Journal, Vol. 45, page 224, Sept. 21, 1918, is operated under a head of 346 feet to supply 4,000 h.p. for the operation of construction plant at the Hetch Hetchy dam 12 miles above on the Tuolumne River, and for the excavation of the main tunnel 18.3 miles long, extending from the power station to the reservoir at Priest.

The water operating the turbines is derived from the Eleanor Reservoir formed by the construction of an impounding dam 62 feet high above steam bed that was built across the Eleanor creek 12 miles from the power station where the bed of the creek is 2,347 feet above the power station, thus providing a very steep slope for the rapid flow through the natural bed of the creek and of the Cherry River into which it empties. About 3.5 miles from the power station, a diversion dam built across the bed of the river turns its water into a concrete lined aqueduct canal, connecting that point with the head of the steel penstock 550 feet long that delivers to the turbines. Both the storage dam and the aqueduct, although built for construction purposes are so designed as to be retained for future service in an auxiliary supply to the permanent aqueduct that will be provided by enlarging the dam and creating a great reservoir to increase the regular city water supply.

IMPOUNDING DAM.

The impounding dam 70 feet high from the lower part of the foundation to the crest, is of the multiple arch type and cost about $283,000. The total length of 800 feet of the 40 arches comprising the main part of the dam is extended to 1,260 feet by a low concrete wing wall at each end. It has a storage capacity of 8,700,000,000 gallons, sufficient to insure, during the dry season, supply for the power house.

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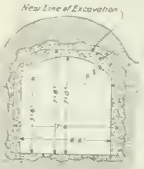
* Part I.—154-mile aqueduct and auxiliaries for ultimate delivery of 400,000,000-gallon daily to San Francisco at estimated cost of $45,000,000. Preliminary work, $2,000,000, including construction of $2,000,000 railroad, 68 miles long. Public Works, March 6; page 165.

The dam is located on the site selected for a storage dam capable of raising the lake level 100 feet or more when it is necessary to supplement the city water supply to be derived at first from the Hetch Hetchy reservoir. The present dam will remain in position ready to be incorporated in the structure of the future high dam.

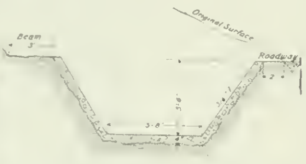
DAM CONSTRUCTION

The first preliminary for building the Eleanor Dam was the construction of 14 miles of wagon road from the dam site to the terminus of the Hetch Hetchy Railroad. This steep and crooked highway is built largely in granite cuts with thirteen switchbacks, most of them requiring several reversals of an automobile truck. In 3½ miles it rises to an altitude of 1,800 feet above the valley floor level, with almost continuous grades of 12½ per cent.

During the construction of the highway a sawmill was erected on Eleanor Creek half a mile above the dam site, and during the first six months produced 900,000 feet of lumber for use in the construction of the dam and its appurtenances.



LINED SECTION OF CHERRY RIVER AQUEDUCT TUNNEL



CANAL AQUEDUCT FOR CHERRY RIVER HYDROELECTRIC DEVELOPMENT.

Cement was hauled from the railroad by a fleet of 12 automobile trucks working two or three 8-hour shifts daily as necessary to transport the 70,000 bags required and maintain a considerable storage at the dam.

Excavation for the foundation was carried on with hand derricks and was made several feet below the bed of the stream in order to avoid danger from seams in the granite stratum. The foundations for the arches and buttresses were carried down from 5 to 15 feet below the surface.

The cost of the cement, delivered on the Sierra Railroad was $2.67 per barrel. The additional charge of 11¼ cents per bag for double sacking it and the cost of trucking amounted to about 90 cents per bag for transportation.

CONCRETING.

Concrete was made of broken stone, sand and gravel. The sand and gravel were hauled by Fresno scrapers to depressed hoppers from which they were passed through screens to large storage bins that delivered by gravity to narrow gage side dump cars running down an incline to serve the 1-yard Foote mixer installed above the crest of the dam.

From the mixer, the concrete was spouted to 1-yard bottom dump cars hauled by an endless rope operated by a single-drum hoisting engine that spotted them in the required positions to deliver to chutes conveying the concrete to all parts of the dam, which was below the service track.

Concreting was commenced in November and special efforts were made to get enough concrete placed before snowfall to enable construction to proceed in the following spring without interference from the usual flood. The concrete was built to a sufficient elevation to provide for six temporary sluiceways before operations were discontinued for the winter December 22. They were resumed on April 22 and the dam was completed in a little more than a year after excavation was commenced.

The 20 main arches of 44-foot span and their buttresses were concreted in wooden forms that, at the beginning followed closely after the excavation. As the work progressed, the forms, in sections 10 feet high, were supported on the heavy falsework trestle built in 20-foot stories as the work progressed. About 11,650 yards of concrete and 262,000 pounds of reinforcement steel were required for the dam, and the concrete was placed at an average rate of about 100 yards per 8-hour shift, although a maximum of 130 yards was made.

The storage reservoir created by the dam has a capacity of 26,700 acre feet, an amount which is so much less than the total runoff of the watershed that it is filled early in the season. The cost of the dam was $283,000. It was designed under the direction of city engineer, M. M. O'Shaughnessy by R. P. McIntosh, hydraulic engineer assisted by R. J. Wood, structural engineer. Frank J. Boothe was resident engineer of construction.

The water from the Eleanor Reservoir is conveyed about 8 miles through the Cherry River to a point where the channel of the latter is crossed by a concrete diversion dam deflecting the flow into the aqueduct. This dam which is built on the rock bottom of the river is only about 6 feet high and 140 feet long, with a gravity cross section and was built without forms. It contains about 80 yards of cyclopean concrete and was built in 15 days at a cost of about $1,500.

AQUEDUCT.

The aqueduct from the diversion dam to the power house has a capacity of 200 second-feet and consists of nearly equal lengths of wooden flume, open concrete lined canal, and partly lined tunnels. As it is located on a steep hillside, there was no

PORTAL OF CHERRY RIVER AQUEDUCT ROCK TUNNEL.

opportunity at the lower end for the construction of a forebay reservoir, so the flume there was enlarged to about three times its normal capacity for a length of more than 2,000 feet just above the power house, to provide storage enough to carry the plant over minor fluctuations of load.

There is one mile of open canal excavated in rock and earth with depths equal to the bottom widths and concrete lining with an average thickness of 6 inches. It is located on the hydraulic slope of 0.001 and is constructed with a 3-foot berm on the uphill side and roadway embankment beyond the 2-foot berm on the downhill side.

The excavation was made with pick and shovel and with drilling and blasting where necessary, and the side slopes were trimmed smooth to receive the concrete that was maintained on the sloping surface by wooden forms braced across the width of the canal. Concrete was mixed in a steam-driven two-bag batch machine mounted on a traveling platform that spanned the canal and advanced as the work progressed. Broken stone and cement were delivered by motor trucks alongside the canal and were brought in wheelbarrows from the storage pile to the mixer. The side walls were concreted in alternate 8-foot sections, atfer which the concrete mixer returned a maximum distance of 200 feet, and concreted the intermediate sections separated by roofing paper expansion joints. The floor slab was concreted last.

FLUMES.

On very precipitous slopes where the cost of excavation for the concreted canals would have been prohibitory, wooden flumes were built with an aggregate length of about 1 mile. It is intended, however, when labor and supplies are more abundant, to replace the flumes with tunnels that can be built and put in service without interrupting the use of the power plant.

Two of the flumes have a 5 x 6½-foot cross section while the storage flume has a 9 x 10-foot cross section. The flumes are supported either on mud sills or on short trestle bents with projecting caps to which the vertical posts in the side walls are knee-braced.

Excavation for the footings of the fills and trestle bents were carried down to solid rock, the supports built after the permanent floor of the flume was laid on them, a wooden rail track was installed there on which were operated push cars delivering lumber for the sides of the flume. There was used in all 1,800,000 feet of lumber which was manufactured at the City's sawmill and transported by train and automobile trucks to the canal line.

EXCAVATING CHERRY RIVER AQUEDUCT CANAL.

CONCRETING CHERRY RIVER AQUEDUCT CANAL.

TUNNELS.

The tunnels, of the same capacity as the canal, have an aggregate length of 1 mile and were excavated with a rectangular cross-section, having a neat height and width of 7 feet 6 inches. The rock bottom is exposed throughout and the sides and roofs are lined with concrete only when necessary to support the rock.

The total excavation of the five short tunnels in this line aggregated about 12,500 yards. About 3,950 feet of the tunnels were constructed for a contract price of $47,530 by the McArthur Brothers, New York and Chicago. The balance of the excavation and all of the lining was done by the city's forces.

TRAVELING MIXER PLATFORM FOR CONCRETING CHERRY RIVER AQUEDUCT CANAL.

PENSTOCKS AND POWER PLANT.

Water is delivered from the lower end of the flume to the turbine through a 42-inch penstock 530 feet long made of riveted steel plates from 3/16-inch to ⅜-inch thick. The pipe was furnished and put in place by the Western Pipe & Steel Co. for a contract price of $7,558. It was installed in a ditch excavated in a hillside so steep that it was necessary to provide for it very heavy concrete anchorages at the foot of the hill just above the power house and at the vertical bends in the line.

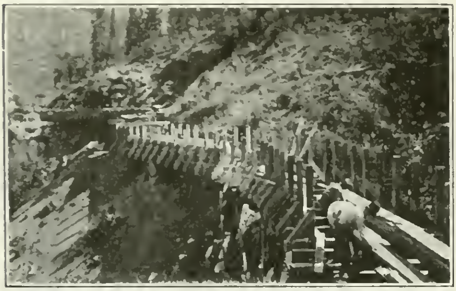
In the temporary steel-concrete power house, there are installed three Francis turbines operating at 720 R. P. M. and each direct connected to a 2,300-volt, 3-phase, 60-cycle generator with direct connected exciter. The voltage is stepped up through a single bank of transformers to 22,000 volts for transmission to the sub stations located along the 19 miles of aqueduct to the west and to the main etch Hetchy dam site 12 miles east of the power plant.

In designing the plant it was intended that the estimated full load of 2,00 K. W. should be carried on two machines, allowing the third unit to be held in reserve.

REVENUE FROM POWER.

A connecting line 4,500 feet in length was built from the end of the City's transmission line to the Sierra Company's line and on September 21, 1918, the City commenced delivering all its surplus power to the company. Between the time when connection was made and July 1, 1919, the city earned from the sale of power a gross income of $67,528.10.

During the fiscal year 1918-1919 the plant generated 18,687,400 K. W. H., of which 13,505,621 have been sold and the remainder, 5,181,779, covers use at the plant, use on the city's work, and line and transmission losses. Five step-down transformer sub-stations are operated, three at tunnel portals and two at shafts, ranging in capacity from 100 to 300 K. V. A. In addition each of these sub-stations is equipped with one 10 K. V. A. transformer to supply current for lighting. All of the power current is being used at 440 votls, 3 phase, while lighting current is single phase 110-220 volts.


CONSTRUCTING TEMPORARY SIDE HILL WOODEN FLUME FOR CHERRY RIVER AQUEDUCT.

With a light winter rainfall in 1918-1919 it was necessary to use stored water from the reservoir until February 3, since which time the run-off has filled the reservoir at Lake Eleanor.

COST AND INSTALLATION OF EQUIPMENT.

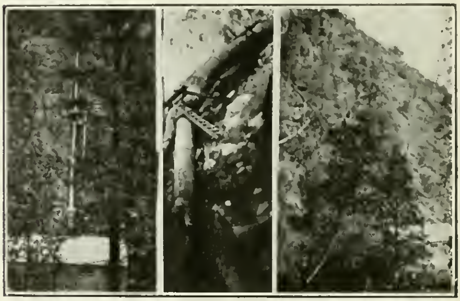
The hydraulic machinery for the power house was furnished by the Pelton Water Wheel Co., for a contract price of $18,814. The electrical generators and exciters were furnished and delivered for $7,700 by the Westinghouse Electric Mfg. Co. There were four machines of the outdoor type, all insulated, water cooled and provided with oil filters.

The transmission line extends 19 miles west and 12 miles east and consists of a single circuit of three No. 4 copper wires on poles cut from local timber. The bare copper wire was furnished by John A. Roeblings Sons Co. for a contract price of $25,215.87. The amount furnished was sufficient for the construction of 38 miles of transmission lines and branches. The insulators, cross arms and pins were furnished and delivered for $3,459 by Pierson, Rodeing Co. The total cost of the canal and temporary power plant was $410,000.

CAMPS

Good care was taken to provide comfortable and satisfactory accommodations for the working force and the principal camp for the Lower Cherry power development was established near the power house at the Early Intake where several groups of comfortable buildings were erected in a very pleasant locality on the river bank as seen in the general view on the front cover, where the building nearest the river is cook house and dining room. Across the road from this building is a large storehouse and at its right, is a bath house where hot and cold showers were installed. All of the other buildings are bunk houses.

The camp is kept scrupulously clean and in good sanitary condition and the meals here as in all of the other camps of the Hetch Hetchy Water Supply are so excellent and the conditions so desirable, that many men remained working for the city rather than accept jobs at other places where the wages were higher, but the comforts were less.


STEEL PENSTOCK FOR EARLY INTAKE HYDRO-ELECTRIC PLANT, INSTALLED ON STEEP SLOPE

Medical attendance and hospital accommodations are provided by the city which has organized and equipped a hospital staff and complete hospital supported by assessments of all of the aqueduct employees including those of the contractors and subcontractors. This arrangement entitles any workman to receive free treatment except for chronic diseases acquired before employment and from disease or injury due to vicious reasons. The cost of the hospital building and equipment was $17,505, that of camps and equipment, $132,875.

The above described work was all designed and executed under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.

Blasting Submerged Mud Cheaply

On the golf links of the Atlanta Athletic Club, there is a small lake. One end of it was covered with stagnant water. It was desired to create circulation of fresh water in this part of the pond and to throw the dirt removed from the bottom of the deepened portion into the center forming an island with a channel of flowing water running around it.

To accomplish desired results, it was decided to blast with dynamite, a semi-circular ditch. The cartridges were simply pushed down into the mud to a depth of 2 feet. The charges following the center line of the proposed channel were spaced 15 inches apart and a half pound of straight 50 per cent dynamite loaded in each hole. A blasting cap was attached to the charge in the center hole of the line. Concussion from the discharge of that charge set off all the other charges down the line on both sides. The shot created a ditch 8 feet wide and 4 feet deep and cost approximately ten cents per running foot.

State Highway Construction in New York

By Jas. H. Sturdevant *

The second of three articles. In this one are described principal features of clearing the site and building the foundation for all types of surface, and standard practice for concrete roads is reviewed, covering supplies, storage and distribution of materials, bins and unloading and elevating methods, concreting operations and concrete mixing.

In the new roads the full width of right of way from 50 to 100 ft. must be cleared, trees felled, cut into logs or firewood and removed, and branches and brush piled and burned.

Stumps and roots must be removed either with horse-power stump pullers or dynamite, and the ground prepared for grading.

Where the ground is covered with heavy timber, the cost of clearing may run from $200 to $1,000 per acre, and be more than offset by the value of the timber and firewood secured. Ordinarily, however, there is little salvage and the work is much lighter, requiring perhaps an average of 2 man-days work per acre. This work is done with gangs of about ten men. The clearing and grading may be done in winter weather with the use of dynamite, but the remainder of the work should be done when the temperature is not below freezing.

FOUNDATION.

The graders should finish the surface to within about 1 inch of subgrade which should be well drained and all soft spots should be replaced with stone or other suitable material to give a solid foundation.

The road surface may be of concrete, or of cement or asphalt macadam, brick, stone blocks, wood or various other kinds of pavement all of which except concrete require to be laid on a foundation course. For macadam roads the foundation course usually consists of stone forming a layer from 6 to 12 inches thick which should be thoroughly rolled with a 10-ton steam roller bringing it to a horizontal cross-section within ½ inch of the required elevation. The stone may be distributed alongside the right of way by cars, automobiles or trucks and then shoveled and raked to position or it may be delivered directly on subgrade and dumped in piles, or even roughly distributed by a dumping-spreader device.

For macadam roads the foundation course is followed by a finishing course of smaller stones similarly applied, dressed to crown curve, thoroughly rolled and finally finished with the rolled binder course.

Brick, stone, and wood pavements should be laid on a solid foundation course, usually of concrete, that is well set before the surface is carefully placed, finished and rolled according to specifications.

CONCRETE ROADS.

The most important feature in the construction of concrete road surface is to do first-class concreting rapidly and continuously which requires a careful study of local conditions and the installation of plant and equipment aranged so as to secure economy of handling and transportation, convenience of operations, and the elimination of delays of all sorts.

The subgrade and drainage should be completed at such a time and at such a rate of speed that the foundation will always be accurately surfaced, ready to receive the concrete a long distance in advance of the concrete mixer, and maintain its relative position beyond the possibility of the concreting operations approaching within 1,000 feet of the grading.

SUPPLIES.

Provisions must be made for the receipt, unloading, proper storage and distribution of cement, sand, and broken stone in sufficient quantities and rapidly enough and with enough reserve surplus to provide, first for local interruptions in the delivery to the mixing machine, and second, for possible interruptions in the general supply due to weather, transportation or other causes, thus necessitating usually the maintenance of a week's supply at the principal storage plants. One of the greatest opportunities for delay, inefficiency and extra cost is in the distribution which must be very carefully worked out to secure the minimum of handling and eliminate unnecessary hauling and delays or interferences.

Abundant water supply must be maintained at all times in the vicinity of the mixing machine, proper shelter provided for cement at the mixer, and arrangements must be made for the continuous operation and forward progress of the mixer.

STORAGE OF MATERIALS.

In the unusual event of aggregate and cement being purchased from large dealers at a nearby point, it may be possible to deliver them daily in limited quantities or by automobile trucks or even by teams and deposited in small quantities distributed along the roads.

Sometimes sand and gravel may be obtained by the contractor at one or more points along the right of way or nearby, or he may open a quarry or take stone provided by the grading excavation and crush it for concrete. In either of these cases, it is likely to be best to establish one or more storage plants at the points of production where it will probably de advantageous to maintain the cement storage unless it is more convenient and economical to deliver the cement directly to the mixers.

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*Division Engineer of first division, Highway Department, New York State, in charge of 12,250 miles of roads in 8,000 square miles of the Hudson River locality.

In many cases sand and gravel or broken stone are delivered on the railroad and on very rare occasions if the latter closely parallels the highway under construction, it may be posible to unload the cars close enough to the right of way to permit of approximate distribution when unloaded and allow the mixers to be supplied from the storage piles by wheelbarrows.

Ordinarily it will be necessary to establish storage at the sidings where the cars are unloaded. The most important point is to devise a system, best adapted to local conditions and topography, that will involve the least time, labor and cost both in unloading, in storing and in reloading for distribution along the line.

TUNNELS AND TRESTLES.

If the siding is on a side hill or trestle, the cars can be readily dumped directly into storage piles that may easily provide for gravity delivery to the distribution system. Where there is sufficient heighth and space it is probably cheaper to build a wooden framework on the surface of the ground covering a service track in turn covered by the aggregate which can be deliverd through gates in the tunnel roof to fill the cars, buckets or batch boxes on the service track.

If it is necesary to use storage bins, they may often be advantageously built with siding and floors attached directly to the track trestle timbers or if on a slope, can be improvised simply with a vertical board wall or bulkhead at the bottom of the slope.

DERRICKS AND CONVEYORS.

If the cars must be unloaded on level ground, the materials will require artificial elevation to storage bins or to large storage piles and are often handled by ordinary boom derricks with clamshell buckets. Elevated bins may be provided with storage capacity for one or two days run of work and the materials loaded into them by the clamshell buckets until they are filled and the remainder deposited in storage piles adjacent to them on the surface of the ground and reclaimed if necessary as the bins are emptied.

The railroad cars may be dumped into a pit, hopper or boot between the rails allowing the materials to be automatically fed to the buckets of a power elevator that fills elevated bins or builds a storage pile on the surface of the ground. Here the bucket elevator system or the side hill system may often be installed at the contractors' quarries or rock crushing plant and the bucket elevators may be used at sand digging and washing plants. It is entirely possible to unload through a hopper to a belt conveyor and to transport stone, sand and cement by this conveyor up a steep slope and discharge it at any point of a long series of bins, and conversely a belt conveyor may be used for delivering sand, gravel, broken stone and cement from storage for distribution.

Cars may be advantageously unloaded by hand with hoppers or chutes attached to the sides of the cars and delivering to service cars, automobiles or trucks adjacent to them on the surface of the ground. In all cases it is of course desirable to eliminate as much as possible hand work in unloading and storage operations.

DISTRIBUTION FROM STORAGE.

Storage plants should be located with regard to their proximity to the railroad or other source of supply, to the highway under construction, and so as to secure the shortest routes and the best grades for loaded vehicles. Usually, they should be placed at central position so that material may be delivered from them up to maximum distances of 2 or 3 miles in each direction.

For large work in level country the delivery on industrial tracks is likely to be the most economical and convenient. Care should be taken to arrange a simple plan for maintaining the tracks up to the mixers and for supplying a constant succession of loaded cars and returning the empty ones over switches and sidings and with cross-overs to eliminate any interference or possibility of interruption. Whether these tracks are laid on the right of way, or on the subgrade and how the return tracks are arranged will depend on circumstances.

The tracks are usually of narrow gage sectional construction and, although dump cars may be used for macadam road construction, they are seldom desirable for concrete roads and flat cars carrying one-yard buckets or batch measuring boxes can be hauled in trains drawn by gasoline locomotives. Batch boxes can be built by the contractor and conveniently filled up to the successive marks with sand, stone and cement, thus providing the required charge for the mixer that can be delivered to its receiving hopper with great rapidity and reduce to a minimum the delay between batches.

The use of batch boxes or buckets on the service train necessitates some kind of an unloading derrick at the mixer which may be provided either by a light boom operated by the mixer engine or by a locomotive crane or any other traveling derrick installed at the mixer. When the mixer is supplied directly by automobile trucks, the latter may carry batch boxes or buckets or they may have special bodies designed to act as measuring boxes for one or two or more batches, according to size of automobile trucks and of mixer. They may even dump on the ground close to the mixer and have the material shoveled into the hopper by hand at the cost of considerable expense and delay.

When sand and broken stone or gravel are distributed in continuous or separate storage piles along the right of way or on subgrade they should be placed on plank platforms or their equivalent that prevent any loss of materials or mixing them with dirt when shoveled into wheelbarrows.

CEMENT STORAGE.

When cement in bags is stored along the right of way great care must be taken to keep it elevated above the surface of the ground to provide against deterioration by moisture and to keep it properly covered and protect it from rain.

Sometimes the cement is stored on top of the stone piles, which insures good drainage. In other cases it has been satisfactorily stored on small movable wooden platforms, 9 to 12 feet square, and covered with tarpauline or with wall tents provided with permanent frameworks that could easily be lifted off from the platforms exposing the piles of cement bags and making them perfectly accessible in pleasant weather, but permitting them to be instantly covered at the approach of a shower.

CONCRETE MIXERS.

All concrete should be machine mixed and the size and location of machines and the motive power should be carefully considered to conform to the requirements and conditions. Machines may be driven with steam, or gasoline engines, electricity, or even by compressed air, and they may be placed at intervals or continuously moved forward as the work advances, which is usually more desirable.

The mixers can be mounted on rolling platforms and drawn forward by any convenient method, but usually special machines designed for road paving are installed that move forward under their own power and deliver the concrete to a bucket automatically hauled out on a swinging horizontal boom that commands a section of the road from 15 to 30 feet long that is concreted from one position of the machine after which it advances an equal distance to the next position and so on. A gang of about 15 to 20 men will operate and move such a machine and finish the concrete if the aggregate and cement are delivered to the machine in such a manner as to avoid hand shoveling, wheeling or loading and unloading. Under favorable conditions a 3-bag mixing machine should average about 500 square yards of roadway 8 inches thick in one 8-hour shift.

CONCRETING OPERATIONS.

The spreading, screening, finishing and curing of the concrete must be made systematic and regular, all following at the same speed as the mixing and accomplished by special gangs, each of whom will be continuously busy without interference.

Special attention must be paid, if need be, to the construction of curbs and gutters, to the control of traffic on the new concrete and in the advance of construction work and to arrange, where necessary for by-passing traffic around working zone.

Prompt Action Necessary

"The aliens of this country, who cannot speak our language, who know not our laws nor our civilization, are being mobilized under the red flag of anarchy by the Bolshevists for the purpose of overturning the American Government and bringing upon us the chaos that exists in Russia.

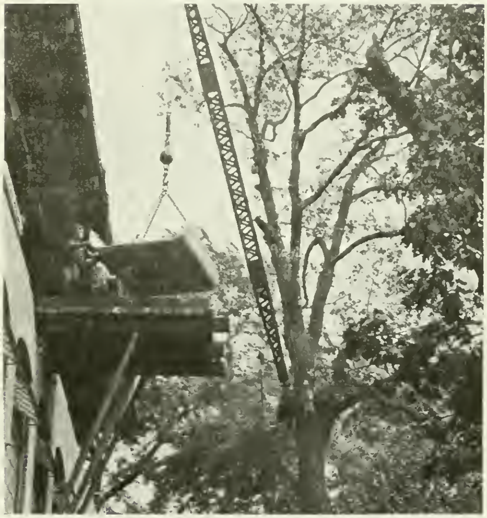
"No alien should be permitted to become identified with political or labor, or social uplift organization of any kind. The alien—alien in thought, in language and in spirit to everything that is American—cannot vote. He must be naturalized before he has the privilege of citizenship. Nevertheless, this same alien by becoming a member of labor, or of other organizations, can have a very powerful effect in shaping the political work of the country.

"These aliens are mobilized by anarchists in radical labor unions for the express purpose of affecting politics, and through politics controlling the country. * * *

"The people of this country have reached a point where they must face once and forever, and settle once and forever, whether such elements shall rule this country to destruction, or whether Americanism shall prevail. The radical labor union of today is the mobilized power of alienism for the purpose of overthrowing the American Government."—*Manufacturers Record.*

Living Derricks

The use of ordinary masts for boom derricks was eliminated and the time, labor and expense of transferring them from place to place and erecting them was also reduced and considerable convenience and economy secured by the Aberthaw Construction Co., Boston, in the erection of a cotton mill for the Nashua Mfg. Co., Nashua, N. H. The work was executed in an oak grove, many of the trees of which had been left standing close to the site of the building so that it was possible to use their trunks for derrick masts.



FOOT BLOCK FOR STEEL DERRICK BOOM SUCCESSIVELY CLAMPED TO TREES SERVING AS DERRICK MASTS.

A yoke of two short horizontal timbers connected at both ends by heavy screw rods was clamped to the tree trunks at any required height, and to one of the blocks there was attached a Chicago foot block for a steel derrick boom, the topping lift tackle of which was connected to the same tree or another one, thus enabling the boom to be operated as in a regular derrick.

This method of course necessitated the trimming away of some limbs to give clearance for the required horizontal swing of the boom, a matter which was not considered objectionable since many of the trees were eventually cut down and could just as well serve this temporary purpose. The boom was easily shifted from tree to tree.

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Immediate Essentials of the Hudson River Tunnel

One of the most important public works at present under consideration in this country is the vehicular tunnel under the Hudson River between New York City and Hoboken, N. J. The cost variously estimated from $15,000,000 to $30,000,000 may, in this time of soaring prices, well enough exceed the upper limit and will depend on the size, type and location of the tunnel which are selective, and on the price of labor and materials which are highly uncertain. A great deal of discussion, some of it rather sharp, has arisen over the dimensions and details of the design, the location of the tunnel and the future amount of tunnel traffic.

It is pretty generally conceded that the tunnel is urgently needed; that the traffic will be great and increasing and will probably soon exceed any ordinary tunnel capacity, and that this tunnel will soon have to be supplemented by other tunnels, preferably located at some distance from it to serve different parts of the city and avoid undue congestion.

It is therefore evident that the subject is neither a single nor a determinate problem, and that it cannot possibly be fully solved at the present time on account of totally insufficient data and changing and uncertain conditions. Immediate and vigorous action is needed and is provided for by interstate legislation; the creation of a tunnel commission with powers; and the provision of liberal funds for preliminary preparations that will be supplemented by ample finances for executing the work.

The thing to do is to build an efficient tunnel as quickly, safely and economically as possible and this may well be left to the able commission, its associates and the eminent engineers and experienced contractors whose services they can command to assist in the development of the detailed design and the execution of the work.

There is no question that despite the serious difficulties of the site, vehicular tunnels are entirely practicable under the Hudson River at New York City. It is feasible to adopt the type, details and location that give the best results according to present knowledge and the state of the art, and even should they not develop the utmost potentialities of the situation, they will undoubtedly give good value for the expenditure and no serious disappointment need be anticipated in the results of the construction.

The knowledge and experience gained in such important work will doubtless point to improvements that can be much more conservatively and successfully applied to future tunnels than to the present one. Under the difficult conditions and uncertainties, radical deviation from standard practice is undesirable considering the large scale and immediate necessity of the construction. Having determined how large a traffic to provide for at this time and bearing in mind that above certain dimensions, the larger the diameter of the tunnel the more difficult and costly it is to build it, the question becomes one of "safety first" plus the most economical methods that will give a maximum efficiency and minimum delay.

Heavy Extra Preliminary Construction Expense Sometimes True Economy

The construction of the great water supply and hydro-electric development for San Francisco, which had been contemplated for about 20 years, was actually commenced about six years ago and is now so far advanced that the legislation, litigation, and most of the surveys and other preliminaries to actual construction, have been finished, work on the permanent structures has been commenced, and plans for the future thoroughly detailed so that the completion of the work in 1823, about 9 years after it was commenced, is confidently expected.

The construction work is on a large scale and in remote and mountainous regions involving great delay, difficulty and expense, features which have been fully appreciated in advance and which, together with the great magnitude and extreme importance of the work have not only justified but demanded unusually thorough preparation for it. The conditions are such that the actual construction of the great dam, impounding reservoir, 18 miles of aqueduct and the power development involve an estimated cost of about $20,000,000, while the other expenses increase the total estimated cost of the project to $45,000,000 inclusive of about 136 miles of aqueduct between the power house and the city which is of comparatively simple construction.

Up to the present time a little more than $8,000,000 has been expended, of which less than $1,000,000 has been directly applied to the primary construction while nearly $3,000,000 has been wisely expended on auxiliary works, the principal ones being the $2,000,000 service railroad 68 miles long and the dam, aqueduct, and hydro-electric plant to furnish power for the main building operations, that have cost $815,000. This power plant, described on page 203, besides being practically indispensable to the execution of the work, is remarkably efficient in its application of natural resources and in the great economy over any other kind of power development that might have been installed. Like the service railroad, it has been wisely planned for permanent retention after the completion of the water supply so that the cost may be properly charged up to permanent valuable property and is still further valuable from the fact that, also like the railroad, it has an important earning capacity enabling it to produce a considerable independent revenue that has already amounted to about $68,000, or more than 8 per cent. of its cost, an amount which may be considerably augmented and which would provide both for interest and amortization charges. This result abundantly endorses the expenditure of less than 2 per cent. of the total cost of the water system in order to do the work much more advantageously than it could have been otherwise accomplished. It is by such far-sighted utilization of all the potential values and by-products of a great scheme that big undertakings are made most profitable and satisfactory.

A Fair Deal for Municipal Transit

The announcement in the public press that Corporation Counsel Burr of the city of New York has moved to seize the property of the Interborough Rapid Transit Co. for operation by the city, or under its direct control, emphasizes a serious situation that calls to Heaven for the elimination of politics, or graft, or profiteering, or all three, for the interests and prosperity of the world's metropolis, the comfort and safety of many millions of passengers, and justice to the owners, managers and thousands of innocent stockholders in the subway property.

Discussion is too much involved and the issues are too great and complicated for any off-hand determination, but it should be remembered that the subways are now intensely vital to the city's life, which they have abundantly developed, and that in spite of their many imperfections and faults they are far and away the greatest and best system of the kind in the world.

While it is no doubt physically possible to serve the convenience of the public and promote its comfort to a greater degree, it is by no means certain that reasonable efforts have not been made to accomplish this, or that it is financially possible to do so under existing conditions, or that if it were it could be rapidly attained in the present labor and equipment markets.

There is no precedent in the world for physical conditions so difficult for the construction of such work on so great a scale as in New York City, nor have they elsewhere been met so satisfactorily and probably so economically. The builders of the subways have conquered what would only a few years ago have been impossibilities; have constructed a wonderful system, and have operated it with astonishing safety and success.

Whatever the very serious and undisputed inconveniences to the public through crowding, the service has many merits and the passengers not only receive their full money's worth, but very much in excess, and it is unquestionably very unfair to compel the company to transport a passenger the maximum distance of perhaps twenty miles, for a single five-cent fare.

It is questionable whether a five-cent fare is a high enough minimum for the shortest distance under present conditions and while the high cost of living, labor profiteering, soaring prices of all materials and equipment and increased taxes have enormously increased the necessary expenses of the company, their revenue has not been permitted to be adjusted to it.

There is no question that justice demands a readjustment of charges to permit the company to earn a sufficient surplus to pay profits and to provide for maintenance, improvements, betterment and extensions. The only real point in doubt is the amount of profit that is just and fair.

The determined and persistent efforts on the part of a certain faction conspicuously represented by the Mayor of the city to discredit and ruin the existing transportation facilities with the avowed desire to assume municipal control and the obvious result of creating an enormous amount of patronage and political influence cannot be sufficiently deprecated and opposed. No intelligent citizen can fail to see that such a course would add enormously to the already outrageous burden of taxation, greatly increase the cost of transportation, and undoubtedly diminish its efficiency and safety by the destruction, invariably following such action, of economy, efficiency, and the incentive to improvement.

Profit Sharing with Labor Impracticable

Those with a maudlin tendency to shout for profit-sharing regardless of whether net returns are profits at all or whether the laborers have manifested any degree of faithfulness or efficiency or have already been overpaid, should read the report of the special committee of the Federation of British Industries which states definitely that profit-sharing is not desired by the workers, who are interested chiefly in obtaining high and regular wages; that the remuneration of the workers ought not to depend on the success or failure of the commercial management; that it would lead to great inequalities between workers in the different establishments; and that except where capital is very large compared with the number of workmen, it would yield only a small addition to earnings.

Profit-sharing is only just and defensible when the profits are in some measure due to extra loyalty and efficiency on the part of the workmen and certainly not when they are derived in spite of the workmen's indifference or incompetence. There is no reason why the fruits of industry, economy and enterprise should be awarded to employes that, as a rule are abundantly well paid for their services, unless they have some additional claim based on extra services or on some participation in improvements that have increased the gains. Too often the employe tries to give a minimum equivalent for a certain maximum wage while the employer bears all of the business risks and anxiety and has to contend with gratuitous labor troubles. Even when able services are entitled to extra compensation the cases are very rare when the labor is qualified to take any part in administration or commercial responsibilities, least of all when it comes to arbitrary control of its own employment, discharge and remuneration, the goal of labor agitators.

New York-New Jersey Vehicular Tunnel

Interstate Commissions, Board of Consulting Engineers and Chief Engineer report in favor of a $28,000,000 double-traffic line, twin-tube structure about 9,200 feet long. It should be constructed in about four years, with an estimated practical capacity of 13,270,000 vehicles annually, that, the engineer assumes, may be fully utilized within ten years after the tunnel is open. The type of tunnel, dimensions, location and method of construction have been discussed at public meetings held by the American Society of Civil Engineers. At another meeting held by the National Highway Traffic Association the dimensions and capacity of the approved design and the possible future traffic were vigorously discussed; the design and necessarily indeterminate estimate of future traffic were attacked by a layman, and in reply the official design and conditions were ably explained by eminent engineers.

The legislatures of New York and New Jersey have appropriated $2,000,0000 for preliminary expenses and have created commissions with power. The commissions have appointed as chief engineer Clifford M. Holland, formerly engineer of tunnels for the New York City subways; and as a board of consulting engineers, Col Wm. J. Wilgus, formerly chief engineer of the New York Central Railroad, Major John A. Bensel, former engineer of New York State, A. Byrne, engineer of plant and structures, City of New York, J. Vipond Davies, consulting engineer, and the late Col. Henry W. Hodge. The chief engineers and the board of consulting engineers have investigated local conditions and requirements, made surveys and subterranean explorations, recorded traffic conditions and considered eleven plans of proposed construction.

After many months of exhaustive study, they recommend to the commission a twin-tube tunnel from Canal Street, Manhattan, to 12th Street, Jersey City, with separate diverging exits and entrances at both ends to develop the potential capacity of the tunnel and eliminate unnecessary congestion.

The report of the chief engineer of the New York State Bridge & Tunnel Commissions on the Manhattan-Jersey City vehicular tunnel under the Hudson River has been submitted to the Governors and Legislatures, but has not yet been issued to the public in print, although an abstract of it has been published by the daily press.

Under the river each of the parallel tunnels will consist of a shield driven cast iron tube 29 feet in external diameter with a concrete lining and a two-line roadway 20 feet wide having a vertical clearance of 13½ feet and a footwalk on one side. The segmental areas above and below the roadway will be utilized respectively for exhaust and supply ventilation ducts.

The tunnel will be nearly level and 3,400 feet long between pier lines with maximum adverse grades of 3.13 and 2.83 per cent. on the wider, three-line approach tunnels about 1,800 feet long at each end. It is expected that the maximum average daytime speed of motor vehicles in the tunnel will not exceed 12 miles per hour and that the tunnel will have at this rate a capacity of 3,200 vehicles per hour in daytime and, judging from the development of traffic on the New York bridges, it should carry about 5,600,000 vehicles the first year and about 8,800,000 vehicles the sixth year, reaching its full capacity about the tenth year. The estimated cost of the tunnel is 28,669,000, which it is believed will be fully paid by tolls during the first eleven years of operation. Construction should be commenced in the fall of 1920 and completed in 1924 with a force of approximately 2,000 men.

Considerable prominence has been given to the construction of this tunnel with a lining of precast concrete blocks, recommended by Gen. Geo. W. Goethals, a type that has been successfully used in the important Mt. Royal land tunnel at Montreal and elsewhere, but which was not considered by its engineers to be most desirable for the Hudson River tunnel. It was therefore determined at a joint meeting of the New York and New Jersey Tunnel Commissions to have each of them adopt a resolution directing the board of consulting engineers and the chief engineers, to devote no further time to consideration of the precast concrete lining.

TRAFFIC ASSOCIATION MEETING.

Under date of March 4th, Elmer Thompson, secretary National Highway Traffic Association, called a public meeting in New York City under the auspices of the association to discuss traffic problems in relation to the vehicular tunnel. The invitations called attention to the early proposition for a single tube tunnel carrying three lines of traffic in each direction, then estimated to cost approximately $12,000,000, and to the commission's recommendation of two 2-line tubes at a present estimated cost of $26,000,000, and emphasized the importance of the traffic considerations involved which merit thorough public discussion. Public officials and other prominent men were invited and the attendance of about 100 included eminent engineers and contractors experienced in public works, and tunnel specialists.

OFFICIAL COMMENTS.

Clifford M. Holland, who was present by special invitation, briefly discussed the selected plan, emphasizing the impossibility of determining in advance accurate conditions or requirements and the necessity for prompt and reliable tunnel service which cannot be at all considered as the equivalent of bridge service but as emphatically supplementary to it and, in the present case, as preliminary. As such it is imperative to build the safest, most conservative, and most economical structure that can be quickly completed according to present knowledge and facilities; the experience and developments thus attained serving as most valuable aid for the design, location and construction of future tunnels which must ultimately be required, whatever the final solution of the problem.

Mr. Holland showed that the approaches to the tunnel correspond to the neck of a bottle where the greatest congestion occurs limiting the service of the tunnel itself and therefore necessitating proper treatment of the approaches. He stated the maximum capacity of the tunnel and described the present commercial and traffic conditions and the methods of traffic investigations that indicated a large and uncertain increase of traffic that he assumed might probably exceed the tunnel's capacity after about ten years' growth. A material change in the capacity or proportions of the tunnel will greatly increase its cost to secure results not at present needed, and modifications, such as the adoption of an elliptical cross-section, would greatly reduce the proportionate area available for ventilation ducts and might increase the operating expenses of the tunnel from $300,000 to $2,000,000 annually, besides which we have no data of a submarine tunnel with elliptical cross-section by the shield method that is suggested for this tunnel. The commission is a trustee of public funds, and must act on uncertainties and approved standards.

PROPOSED FOURTEEN-LINE TUNNEL.

T. K. Thompson asserted that it was impossible to build a stable tunnel in the Hudson River at New York by the shield method and presented a plan for a concrete tunnel with rectangular cross-section 177 feet wide and about 35 feet high outside, with six 25-foot passageways to accommodate two or three lines of vehicles moving in the same direction in each. The tunnel to be built in sections, 700 to 1,000 feet long, floated to the site and sunk in position on a pile foundation in a dredged trench. The whole to be built for $20,000,000.

OFFICIAL PLANS ATTACKED.

In the general discussion which followed, one of the first speakers made a violent attack on the alleged inadequate capacity of the tunnel and on Mr. Holland's careful and systematic methods of estimating future traffic which were ridiculed without, however, offering any evidence in opposition to them other than that of his personal opinion and assertions. The speaker's idea being that an almost unlimited quantity of traffic not now carried would immediately overwhelm the tunnel simply because the latter had become available.

TRAFFIC POSSIBILITIES.

Other speakers referred to the tendency, when new surface routes have been opened, for traffic to automatically shift to them and to create an increase in the total volume of traffic rather than simply change its arrangement.

It was pointed out that provision must be made for three entirely distinct kinds of traffic, namely, horse-drawn vehicles, faster moving trucks and other commercial vehicles, and the fastest moving automobiles, which must to some degree be separated, although it was also pointed out that horses are becoming an increasingly negligible factor and that the relief to the ferries would afford them much greater and more desirable service there, even if they did not enter the tunnel at all.

The difficulties of overload or unreliable motor vehicles on the grades, the possibility of breakdowns and blockades, and the limitations of clearances between the different lines of traffic were discussed. It was stated that the clearance could be materially increased by modifying the diameter of the tunnel, but that for three lines of traffic, a larger diameter of tube is certainly necessary and would greatly increase the cost.

It was pointed out that the traffic capacity of the approach streets is reduced by intersecting streets, and that while a density of 0.6 of a vehicle per foot of roadway per minute requires relief, it is exceeded on Park Avenue. A moving sidewalk type of platform was suggested to develop maximum tunnel capacity.

COST AND LOCATION.

It was suggested that since there must necessarily be future tunnels, the plans should consider their location on widely separated lines and that they be provided with multiple entrances. The three-line traffic tunnel was estimated to have from 50 to 100 per cent. more capacity than the two-line tunnel, and estimates of $15,000,000 and upwards for the costs of different type and capacity tunnels were offered for tunnels with 22½ to 24-foot roadways.

J. F. O'Rourke, speaking as an engineer and contractor, stated his willingness to build a tunnel with either the cast iron lining or with the precast concrete block lining and asserted that a 28-foot diameter tube with a 23½-foot roadway could be built by the latter method for $17,500,000, while the same tunnel built with cast iron lining would cost $30,240,000.

THREE-LINE TUNNEL

The minority report to the commission was called for and read. It recommended a three-line of traffic tunnel, for which it assumed a roadway 24½ feet wide would be adequate and would involve a cost of 14 per cent. more than a two-line tunnel. These conclusions were disputed by Col. W. J. Wilgus, who stated that the increased cost would be about 21 per cent., equivalent to $6,000,000, and that the 24½-foot roadway would afford very inadequate clearance for three lines of traffic, a condition which would result in pocketing the traffic. The engineers have given very great attention to the tunnel lining and have selected one involving a known expense, but are still at liberty to adopts any known expense, but are still at liberty to adopt any and economy.

At a late hour, a resolution was offered to the effect that it was the sense of the meeting that a two-way 22-foot roadway tunnel would very soon become inadequate, and that steps should be taken for the investigation and consideration of a larger tunnel. After denials that this resolution was prepared in advance of the meeting and that it was in typewritten form, the resolution was carried against a considerable negative vote.

Cement Joints Economical in Cast Iron Gas Pipes

The conclusion drawn from records of two years' work in laying large quantities of cast-iron pipe 4 to 30 in. in diameter is that the cost of cement mortar in hub and spigot joints is only from 25 to 50 per cent of the cost when they are calked with lead.

In discussing this subject in a paper presented to the Pacific Coast Gas Association, W. M. Henderson said, in part:

"The practice which is more or less general of using neat cement for packing the joint is not proper, and will not give the satisfaction obtained from a mixture of portland cement and sand. Neat portland cement, in setting, rises in temperature over a range of 60° F. to 150° F., or not in excess to 10° F. in 12 hours. This is considerable expansion during setting of neat cement, which will likewise be followed by contraction. This fact accounts for the shrinkage cracks. Quick setting cement is preferable, but cements in the market give little choice in this respect. Good clean sand, not too fine, and not necessarily sharp, will make a strong mortar. The yarn is also an important factor; the old hemp rope, the standing rigging from sailing vessels, cannot be excelled.

The best mixture for the joint is three parts cement to one part sand, and just sufficient water to make a dough that will hold its shape. The quantity of cement, sand and water, should be mixed as necessary for each joint as it is made.

In laying pipe for cement joints the procedure is very much as with lead, with a few additional precautions. The pipe must be in its permanent resting place well blocked and tamped. As much as possible of its surface should be covered with earth, so as to protect it from change of atmospheric temperatures. One should also avoid stepping on the pipe when getting in and out of the ditch; this should be a hard and fast rule, particularly after cement joints have been made up and are green. The joints are best made in the afternoon, permitted to set through the night and tested the first thing in the morning. If they are found to be tight, the backfilling should be done at once to protect the pipe from the heat of the day. Those joints left exposed during the day must be shielded from the sun's rays, and it is well to cover them with a wet sack as addition protection.

In making the joint the bell is first cleaned by the hand bellows. Then a strip of hemp yarns is placed in the bell and driven home; this should be made tight. The balance of the bell is then filled with the mixture of cement grout; this is usually placed in the joint with the fingers and rammed in by a yarning iron or a wooden tool of similar shape. The cement is packed until it properly fills the bell, then another strip of yarn, coated with mortar, is set in the bottom of the bell and forced into the ring. The balance of the space to the face of the bell is filled with either neat cement or the same mixture and the entire joint is pointed at an angle of 45°."

Cost of Making Lead Joints.

Size of Pipe		Lead Per Joint	Yarn Per Joint	Time Per Joint	Total Cost
	Quantity	10-lbs.	.33-lbs.	12 Min.	
4"	Cost	.77	.042	.1375	.95
	Quantity	12.lbs.	.50-lbs.	12 Min.	
6"	Cost	.924	.063	.1375	1.12
	Quantity	18-lbs.	.55-lbs.	15 Min.	
8"	Cost	1.386	.07	.1718	1.63
	Quantity	20-lbs.	.80-lbs.	20 Min.	
10"	Cost	1.54	.102	.2291	1.87
	Quantity	24-lbs.	.80-lbs.	24 Min.	
12"	Cost	1.848	.102	.275	2.23
	Quantity	32-lbs.	1.20-lbs.	30 Min.	
16"	Cost	2.464	.152	.6875	3.30
	Quantity	42-lbs.	1.66-lbs.	30 Min.	
20"	Cost	3.234	.21	.6875	4.13
	Quantity	50-lbs.	2.00-lbs.	40 Min.	
24"	Cost	3.85	.254	.9166	5.02
	Quantity	70-lbs.	2.75-lbs.	60 Min.	
30"	Cost	5.39	.349	1.375	7.11

Cost of Making Cement Joints.

Cement Per Joint	Yarn Per Joint	Sand Per Joint	Time Per Joint	Total Cost
3-lbs.	.25-lbs.	2.00-lbs.	15 Min.	
.018	.032	.025	.1718	.25
5-lbs.	.33-lbs.	3.33-lbs.	15 Min.	
.045	.042	.042	.1718	.30
6-lbs.	.50-lbs.	4.00-lbs.	20 Min.	
.054	.063	.05	.2291	.40
8-lbs.	.66-lbs.	5.33-lbs.	24 Min.	
.072	.084	.068	.275	.50
10-lbs.	.75-lbs.	6.66-lbs.	30 Min.	
.09	.095	.083	.3437	.61
12-lbs.	1.00-lbs.	8.00-lbs.	30 Min.	
.108	.127	.10	.6875	1.02
15-lbs.	1.25-lbs.	10.00-lbs.	40 Min.	
.135	.159	.125	.9166	1.34
23-lbs.	1.75-lbs.	15.33-lbs.	60 Min.	
.207	.222	.192	1.375	2.00
30-lbs.	2.00-lbs.	20.00-lbs.	1 hr. 20 Min.	
.27	.254	.25	1.8332	2.61

Excavating a Mountain of Rock

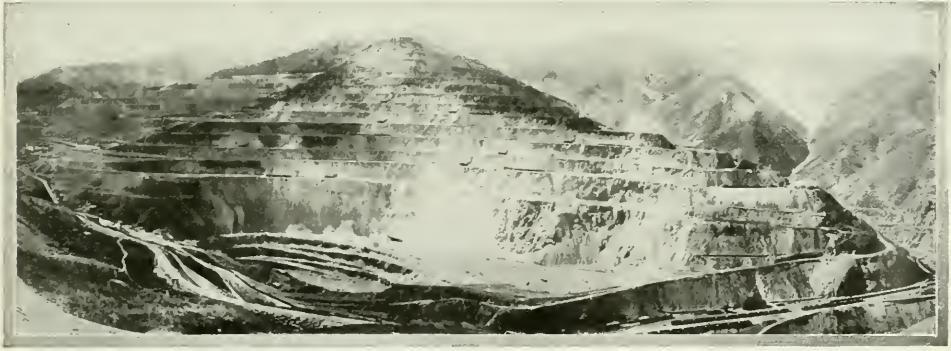
Millions of yards of hard rock and ore excavated by twenty-one steam shovels digging eighteen successive terraces.

The Copper Queen Mine of the Phelps-Dodge Corporation at Bisbee, Arizona, consists of about 10,000,000 yards of very hard rock and ore forming Sacramento Hill which is an igneous mass of monzonite-corphry located between the ports of Bingham Canyons.

The rock and ore are being removed from the surface for a height of 1,600 feet by steam shovels operating in 18 successive terraces from 40 to 250 feet wide, average 100 feet, and with height of 60 to 120 feet. At the bottom of the mountain the average vertical distance between terraces is about 70 feet. During 1918, notwithstanding the war conditions and difficulties of industrial operations, more than 4,270,000 yards of rock and nearly 6,000,000 yards of ore were excavated and the operations had been systematized and are progressing with increasing rapidity.

BLASTING IN TERRACES.

Operations were commenced by blasting off about 150 feet of the sharp top of the mountain. Holes were drilled with churn and air drills, charged with about 11 tons of powder and simultaneously fired, making a fairly uniform surface on which grading and track laying were immediately commenced. The top of the mountain was reached by about 2¾ miles of railroad track, most of it at a grade of 2½ per cent. with sharp curves and two switchbacks.



TWENTY-ONE STEAM SHOVELS, WORKING IN EIGHTEEN LIFTS, REMOVING A MOUNTAIN 1,600 FEET HIGH, CONTAINING 10,000,000 YARDS OF HARD ROCK AND ORE.

Three hundred feet of the upper part of the hill is being removed in four terraces with 3 sections 60 feet high and one with a maximum height of 120 feet. The excavation of the upper bench was commenced first and was kept well in advance of the lower benches in order to avoid possibility of undermining.

In the lower benches the 3½-inch holes about 30 feet deep are drilled by an F-24 Ingersoll machine and are protected by a box at the top of the hole. The holes have a tendency to ravel and some that have been drilled by cyclone drills were cased with iron pipes to prevent them from filling up.

LOADING AND FIRING.

The holes are loaded with red H. No. 4 dynamite marked 60 per cent. and manufactured at Bachus by the Hercules Powder Co. In June, 1919, 369,000 pounds of explosives were used to shatter 1,035,000 yards of rock.

The holes are sprung with a preliminary charge of explosive and, before it is fired the workmen are warned by a long whistle and three short ones and take refuge in huts made of old railroad ties. A completion of the blast is signaled by two long whistles after which the men return to their work. Large fragments of rock are block holed when necessary and the loose material is barred off and forms slopes of about 75 degrees that are removed by the steam shovels of which there are now in use 17 Marions, two Bucyrus and two Atlantic.

HANDLING ROCK AND ORE WITH STEAM SHOVEL.

The shovels are installed on tracks about 25 feet from the service tracks on which five-car trains receive the ore that is hauled by locomotives. All of the shovels are covered by a housing of ⅜-inch planks, sheathed with steel to protect the crew of engineer, fireman, crane man and coal man from flying stones. Each shovel also requires a crew of five to lay the five foot lengths of track ahead of the shovels, operate the jack screws and keep the loading track clear of broken ore.

Owing to the fact that coal can be secured within a distance of 130 miles from the mine, the shovels are still operated by steam, although it is anticipated that electric shovels will eventually supersede steam shovels.

Each shovel makes a cut from 20 to 25 feet wide and each terrace is equipped with one line of compressed air and another line of water pipes.

The steam shovels deliver into 30-yard 5-ton automatic Clark cars, 12-yard Oliver cars and on the top level into 4-yard and 6-yard crab cars.

STORAGE.

Parts of the material are sent directly to the mills and the remainder containing a smaller percentage of copper is stored until it can be treated at the leaching plant. Considerable difficulty has been encountered in providing storage places and a number of service tracks are run up different to provide spoil banks in three of which, 20,000,000 tons have already been deposited. Ore is taken to the mill, which has a capacity of 4,000 tons per day, in 20-yard side dump cars that discharge their contents to a grizzly over a 56 x 84-inch rock crusher. When operations were in full swing last year, from 20 to 25 trains per hour were delivered from the four upper benches.

The work is under the direction of A. G. Goodrich, chief engineer, and Arthur Notman, general superintendent.

Pompton Lakes Municipal Hydro Electric Plant

A population of three thousand is a rather inconspicuous figure in this country of large cities, yet when it comes to initiative, the town of Pompton Lakes, N. J., demands recognition. Proof of this claim may be found in the development of its municipal hydro electric plant.

The former municipal power station was typical of a large number of plants established throughout the United States. Motive power for the two 50 kw. generators was provided by 75 hp. gas engines, and a daily consumption of from two to three tons of coal was essential. In addition to this, the staff expense was comparatively high as it was necessary to employ a superintendent and four assistants.

With an increasing use of power, the authorities found that the old station would not be large enough to supply the demand and it was decided to build a new power plant on a more generous scale and also on a more economical basis, utilizing as motive power the overflow from Pompton Lakes. These lakes, which are fed by the Ramapo River, are comparatively close to the town.

A subscription was raised, and the dam was purchased from the Corning estate by the municipality. New headgates were installed and a flume, 100 ft. x 24 ft. x 10 ft., was built from the dam to the power station, the overflow operating two S. Morgan Smith vertical water turbines of approximately 125 hp. and 225 hp. capacity at a 21 ft. head. Woodward oil pressure governors 6 inches x 12 inches and 5 inches x 9 inches are used.

The turbines are direct connected to vertical generators of 100-kv-a. 300 rpm. and 250-kv-a. 200 rpm. capacity respectively, the combined weight of the water wheel and generator rotors being carried by a Kingsbury thrust bearing supported by the upper guide bearing bracket of the generator. As the peak load at present is only 85 kw., the smaller unit develops sufficient power to meet this demand, but both units are operated alternately. The exciters are belt driven by one quarter-turn belt and idler. The generators operate at 2,400-volts, 3-phase, 60-cycle with 125 volts excition.

A balanced regulator furnishes current for street lighting at 2,400-volts.

The generators, exciters, street lighting transformer and the 5 panel switchboard controlling the entire equipment were built by the Westinghouse Electric & Manufacturing Co.

The building is a 30 ft. x 60 ft., two-story, brick structure, concrete floored, and with a general office, transformer room, generator room and a garage, affords more than ample space.

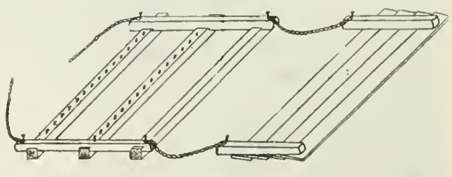
In addition to house lighting for the town, this plant furnishes current for approximately thirty miles of street and road lighting, operates the pumps that supply the local reservoir and is used by five factories, and an electrified coal elevator. In the near future, electric power from this station will also be used by the towns of Riverdale, Pompton Plains, Haskil and Midvale.

The efficiency of this power plant is unusually good and it is stated that the net operating cost is only about one-third of that of the old station. Certainly with the prevailing situation, Pompton Lakes is in an enviable power supply position.

Mr. J. A. Burrell, chief engineer, and two assistants constitute the staff, as compared to the staff of five required to operate the old station.

Home Made Roadway Planer

A roadway planer designed and successfully used by E. H. Winslow, chief engineer of the South Carolina State Highway Commission, is a combination of spiketooth harrow, drag and smoother that can be drawn by six mules or, preferably, by a tractor. It can be built by any carpenter or blacksmith and has been constructed for as little as $15. The 1¼-inch square spikes should be 8 inches long and case-hardened and the frame may be made of timber or even of old railroad ties. It is not intended to take the place of a plow and its dimensions are such as to span short depressions and cut off only the high points of the road surface, thus equalizing humps and hollows.



ROADWAY PLANER FRAMED OF SQUARE TIMBERS.

The Pennsylvania State Highway Department Engineering School has for the March term, an attendance of 350 construction inspectors, county road superintendents, assistant engineers and district engineers, and is the first school of its kind instituted by an American commonwealth.

Moving Harrison Street Viaduct.

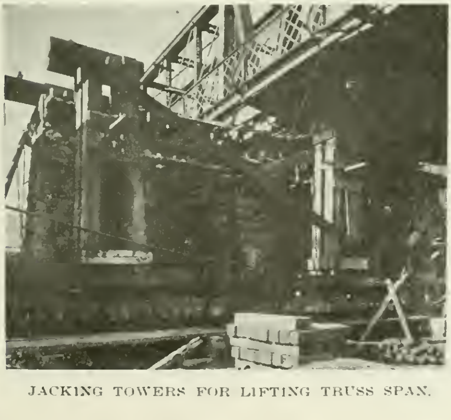
The construction of the new Union Station Terminal, Chicago, required the rebuilding of the Harrison St. viaduct more than 500 feet long which is being reconstructed in two longitudinal halves. The old structure consisted of three 146-foot trussed spans and one 78-foot plate girder span all of which were moved transversely 18 feet and raised 2 feet vertically to carry traffic while the first half of the new viaduct was built on the site formerly occupied by the old viaduct.

The piers and abutments of the old structure were extended, in the direction of the movement, by crib work and by framed tower bents, both carrying skid rails to support the trussed spans during transit. The spans were connected by longitudinal 24-inch I-beams and the trussed members were reinforced by temporary wooden struts.

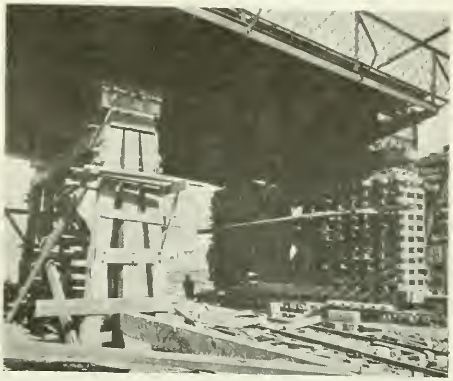
Four-post wooden jacking towers were erected under the ends of the trusses and jackscrews placed under them were operated to lift the spans 2 feet, enabling timber sills parallel to the abutments to be placed under the ends of the spans and seated on solid cast steel bearings on the skid rails. The jackscrews were then slacked off, permitting the spans to be supported on the skids and in 12 hours the bridge was moved transversely to the new position by securely braced horizontal jackscrews.

The plate girder spans were handled in a somewhat different manner. Transverse timber roller tracks were built on the surface of the ground under each end of the span, long hard wood rollers about 3 inches in diameter were placed on them in two groups, and above them were set long track timbers, each set supporting a pair of timber cribs, one under each side of the spans. These cribs were built up nearly to the under side of the girders, jackscrews were set on them and supported pairs of transverse timbers that were adjusted to bearing against the bottom flanges of the main girders.

When all was in readiness, the jackscrews on the cribs were operated to take the weight of the span from the abutments and transfer it to the cribbing and the spans and cribs were moved transversely on the roller tracks, the live rollers being taken out in the rear and replaced in front as they were released by the advance of the span. After reaching its new position a falsework timber tower was wedged up under the span near the end as shown in the illustration.



JACKING TOWERS FOR LIFTING TRUSS SPAN.



FALSEWORK TOWER AND END CRIBBING UNDER PLATE GIRDER SPAN.

After the construction of the first half of the new viaduct, the old viaduct will be dismantled and removed and the second half of the new viaduct will be built in its place.

While the old viaduct was being moved, work was commenced on the construction of the superstructure of the new viaduct. The foundations were built in caissons 4½ feet wide and 48 feet long which carry the new viaduct columns. The old viaduct was moved by the L. P. Friestedt Co., Chicago.

Illuminating Gas Oil Supply Seriously Threatened

Large quantities of oil are used by the gas companies of New York City in the manufacture of the type of illuminating gas generally used in the metropolis. This is known as water-gas, is prepared by passing steam through anthracite coal heated to incandescence, and then enriched by the addition of oil and certain carbons to increase the lighting value. The New York and Richmond Gas Company, supplying Staten Island with illuminating gas, is entirely equipped for the manufacture of water gas and could not change its plant to manufacture coal gas for a period of several months. The company's contract for gas oil will expire on March 31, and the company is decidedly uncertain as to its ability to secure supplies of such oil after that date. Oil companies to which the gas company has had recourse have stated their inability to furnish the necessary oil. Other companies may be in the same situation shortly and the Public Service Commission for the First District, New York, has therefore called a hearing, in order that the facts may be determined as a basis for possible future action.

An Unsuccessful Waterworks Plant

A municipal plant in a city of five thousand population has been outgrown, no considerable increase in capacity or efficiency having been made in twenty-five years. It may break down any day, with disastrous consequences.

It is not often that a public official admits that a municipal plant is not a success; but much can be learned from failures as well as from successes, and because of the lessons that it seems to convey, we are giving a description of a plant which is not a success. The name of the city is not important; it is only necessary to say that it has about 5,000 population and it is in the state of Illinois.

Water is obtained from two 6-inch wells 125 feet deep, from which it is pumped into a water tower 110 feet high. There is only one pump, a single-acting, triplex, plunger pump. For operating it there have been installed a fifteen-horse-power electric motor and a twenty-five-horsepower gas engine. Concerning the entire plant, the superintendent (a local plumber) writes: "The only thing up to date is the meters—every service is metered."

The capacity of the wells was practically reached two years ago, when the water level was so reduced that the pump pit and pump were lowered twelve feet. (The question occurs whether it would not have been better, and cheaper in the long run, to have put in one or two additional wells.) The pump pit was made large enough to install another pump, but this has not been done. To supply the consumption, the pump has to run an average of about 20 hours out of the 24, and if it should ever break in such a way that it could not be repaired within a few hours, the city would be entirely without water.

The power first used was a motor with an automatic starter and stop, for starting the pump when water was low in the tower, stopping it when the tower was full. So long as this operated, the only attention required was to oil the pump once in a while. This plan operated well for two years, but one night something failed to work and the motor was damaged to an extent requiring $700 for repairs. The city then bought a gasoline engine as a stand-by but continued to operate the motor, but this again was burned out six months later and repairing it cost $1,000. The city then decided that it would be necessary to keep a man at the plant all the time. Concerning the gas engine, our informant states that there has been considerable trouble with this also, but does not designate just what this has been, simply stating that it is out of order about half the time. Either one costs about $1,000 a year to operate. He believes that steam would be both more reliable and cheaper than either gasoline or electricity, so long as it is necessary to keep some one at the pumping station continuously.

As to the relative costs for interest and depreciation on the electric and gasoline units, this cannot be given, because no record has been kept of the cost of any parts of the plant.

The steel water tower, when erected twenty-five years ago, was guaranteed for twenty years, and the superintendent says that it should be condemned.

Summing up, he states that the plant has been outgrown and is too small, the wells have not sufficient capacity and more water is needed, the pressure is very poor, the pumping station is too small and is out of date, the pumping plant is liable to break down at any time and entirely stop the service for an indefinite period. There are 800 water takers, the largest being the creamery which uses about 6 million gallons a year. The rate is 25 cents per thousand gallons up to 100,000.

This plant certainly seems to need a complete overhauling and reconstruction after its 25 years of service. It would appear as though there had been a general failure to appreciate the importance of keeping its various elements up to effective capacity and serviceability. It may, of course, be that at no time when improvements were needed did the company feel financially able to make them, but it would seem as though the time is not far distant when it will either have to abandon this plant or incur, all at one time, a very considerable expense which will be felt more seriously than the same or a less total distributed over a number of years.

A Mountain Climbing Motor Truck

Ten years ago it took 28 mules three days to transport a nine-ton boiler 5,000 feet up in the Sierras to the Madera Sugar Pine Mills, 60 miles distant from Madera, Cal., the nearest railroad point. Recently a five-ton Federal motor truck performed the same task in one day, despite the prophecies it would never make the steep mountain grades and pitches.

The roads were considered treacherous, full of dangerous winding turns, often attaining a grade of 20 per cent. Experienced truckmen who saw the boiler loaded from a flat car to the truck prophesied that the trip could not be made, but it actually arrived at the mills, 65 miles up in the mountains without a mishap.

There are many of these donkey engines at the mills in addition to locomotives which are used for hauling timber from the forest to the mills. All of this machinery must be hauled over the mountain roads. The value and economy of the new method, which replaced mule transportation, is strikingly illustrated in the incident related above.

In order to save the brakes of the truck which carried this nine ton boiler, it was necessary to chop down one of the larger trees and drag it behind the truck whenever a steep grade was reached.

In one place the flume, which permits the lumber, cut up, to float down to Madera, had to be cut to allow the truck to pass with its huge load.

This unusual and tortuous trip was successfully accomplished by Clarence Row, one of the expert mountain drivers of this motor truck line, whose experience on this particular mountain road was to a great degree responsible for the success of the trip.

Importance and Economy of Salvaging Road Asphalt

Details of Cost of Reworking and Relaying Worn Asphalt Pavement Surfacing in Washington, D. C.

54 Willow Avenue,
West Somerville, Mass., March 4, 1920.

Sir:

I was quite interested in the three paragraphs on page 106 of the February 14th edition of "Public Works," the subject of which was "Use of Removed Material," and it struck me that the salvaging and reworking of old materials taken from worn places and surface cuts in bituminous pavements was somewhat lightly treated in the article, as I have in mind at least one case where the practice of reheating, remixing and rehabilitating this old material has been carried on since 1912 with excellent success and an enormous saving of mineral aggregate as well as an appreciable saving of the bituminous content of the old pavement.

The city referred to is Washington, D. C., in which there was laid a daily average of approximately 460 square yards per day of 2-inch thick pavements consisting of reworked old material, for the year ending June 30, 1918, and previous records indicate that this is a fair example of what had been done during the several years preceding 1918.

My recollection of the formula under which this pavement was made is as follows:

Old material, 66 per cent; fine sand, 23 per cent.; trap rock screenings, 6 per cent.; limestone dust, 2 per cent.; bitulithic cement, 3 per cent. This may not be the exact formula but is a very close approximate.

Extraction tests made on the result of mixture show a bituminous content soluble in carbon bisulphide of 9.8 per cent. This would indicate that, irrespective of the saving of the old mineral aggregate, there was accomplished a very considerable saving in bitumen.

This practice, of course, results, not only in the actual saving of the material, but in a very appreciable saving in labor cost as well, which would otherwise be involved in the carting of this old material to a dump.

I have an idea that one of the reasons that this practice is not generally followed is because of the lack of the proper kind of equipment for economically reheating and reworking the old pavement.

The plant employed by the District of Columbia has a capacity of 1,000 square yards per day of new pavement, and which will turn out from 500 to 600 square yards per day of old pavement. This plant is of such a design that it can be employed with equal success in the reworking of old pavement or in the manufacture of new pavement and can be alternately used for either service without any change whatsoever in the plant. A great many cities have municipal asphalt paving plants, of a different design, which can only be utilized in the manufacture of new paving material.

It might be interesting to you also to know that the city of Milwaukee, Wis., also follows out practically the same scheme of reworking old pavement as that followed by the city of Washington, employing the same type of plant. I believe that investigation of this particular condition would develop some very interesting data.

The information that I have given you is, of course, only a close approximate and has not been verified as regards its application to existing conditions, but if you care to use this information for publication you are welcome to do so.

Your very truly,
H. L. ALLEY.

P. S.

Mr. Alley supplemented this interesting statement with some data, published about a year ago on asphalt costs in the District of Columbia, which stated that at the municipal plant they had been, the previous year an output of 151,152 cubic feet of old asphalt re-worked mixture at an average material cost of $0.0844 and a total cost of $0.4529 per cubic foot in place.

Reserve Pumping Unit Saves Kalispell $15,000 Annually

The water supply for the city of Kalispell, Montana, is handled by an electric pumping station with a capacity of 8,750,000 gallons daily. Recently the mayor of the city secured a reclassification of insurance policies in consideration of the installation by the city of an auxiliary reserve pumping unit equal to one of the electric units already in service.

A steam turbine, operated from a 250 h. p. water tube boiler, was coupled to the extended shaft of one of the electric pumps and thus provided for any interruption of the electric service furnished from a hydro-electric plant which has heretofore never been subject to interruption.

The provision of this reserve satisfied the insurance company and secured the reclassification which has reduced the rate about 33 per cent., thereby effecting an economy to the property holders in the city of about $15,000 per year in premiums.

Waterworks superintendent, W. H. Lawrence, writes that he has never yet had occasion to use the steam plant for pumping water, but that it meets requirements and is ready for service if needed.

Contractors' Percentage Fees and Estimating Charges

The contractors' committee of the local building exchange, Duluth, have made the following recommendations to govern contract and sub-contract work:

Percentages adopted on all percentage work $1,000 to $5,000, 15 per cent.; $5,000 to $25,000, 12½ per cent.; $25,000 to $50,000, 10 per cent.; $50,000 to $100,000, 9 per cent.; $100,000 to $200,000, 8 per cent.; $200,000 to $500,000, 7 per cent.; $500,000 and up, 6 per cent. This is to include all small equipment; engines are to be charged for at the rate of $2.50 per day; steam concrete mixers the same; small gasoline mixers $1.50 per day; derricks and special equipment at special rates.

A charge of 1/10 of 1 per cent. is to be made for furnishing preliminary estimates on buildings for owners and architects; this charge to be refunded when the estimator secures the work.

Each proposal is to include this clause: "This proposal is subject to acceptance within ten days from date."

We object to furnishing certified checks when bidding for private parties.

We object to paying for plans whether for ourselves or for sub-contractors.

We recommend that the uniform contract as adopted by the American Institute of Architects be adopted by the local architects.

We object to paying for the privilege of figuring plans, unless the check given is returned when plans are returned in good condition.

We recommend that no unit prices be furnished except by the successful bidder when the contract is signed, and when such units are furnished there are to be two unit prices; one for additions and one for deductions. These unit prices are to be based on the governing prices of labor and material at the time of submission of bids.

We recommend that the lowest bidder be paid for figuring plans and submitting a bid when no contracts are let—this payment to be based on 1/5 of 1 per cent. of amount of the bid.

We recommend that responsible bidders only be invited to figure and that no one be asked to figure unless the architect himself and the owner are willing to let the contract to such bidder.

We recommend that the specifications provide that each sub-contractor shall pay his proportion for cutting and patching.

We recommend that the different items entering into the specifications be subdivided by paragraphs and that all items be specified in their respective paragraphs; each one of which should be governed by the general conditions of the specifications.

We recommend that the architect specify clearly whether the owner or the contractor, is to furnish temporary heating for the building. We recommend that the specifications be more specific as to the number, amount, and locations of different articles; for instance, no such clause as this should exist: "Furnish material where required by architect." We recommend when bids are advertised to be in at a certain time that no bids be considered when received after such time.

We recommend that the contract provide for an adjustment in case the wage scale is changed during the life of the contract.

Dynamiting Earth Cuts for Highways

It often pays to blast down high banks along highways with dynamite in preference to employing old style pick and shovel methods or rooters drawn by teams. In many cases, stumps are encountered on top of the banks and gravel or small boulders are interspersed through them. These make it difficult and often impossible for the teams to pull the rooters and the breaking of machinery or harness or the injury of the horses may result.

Frequently by putting down vertical holes in the top of the banks, 3 to 5 feet back from the face and loading them with a few cartridges of dynamite, much time and labor are saved. The banks are thrown down into the roadway in loosened condition ready to be loaded on wagons or removed by scrapers and used for fills.

There are cases where dynamite has thrown down as much dirt as a result of twenty minutes' work putting down and loading holes as teams and rooters could remove in a day.

Menton Sand and Gravel Plant

Aggregate for about 6 miles of road near Menton, Ind., has been very satisfactorily produced by E. A. Gas, Warsaw, Ind., contractor, who installed a portable plant for washing and storing sand and gravel that reduced its cost to about one-third of that of aggregate purchased in the market and shipped to the site.

The plant was installed on a large gravel bed containing a high proportion of sand. A bucket elevator, with the boot covered by a horizontal grating was erected and delivers into a circular screen that grades the pebbles from ¼-inch to 2-inches and discharges them into elevated storage bins from which they are loaded by gravity, as required for transportation to the concrete mixer. The pebbles are washed by water pumped from a near by well through a 4-inch pipe and ahd the sand, graded to ¼-inch, is received in settling tanks from which the surplus overflows to make an adjacent fill.

Sand and gravel are delivered to the grating over the elevator boot by three teams operating scrapers and producing an average of about 60 yards of aggregate daily. As fast as the haul becomes excessively long for the scrapers, the plant is readily shifted and is thus kept in continuous operation with a maximum capacity of 75 yards per day. The elevator and screen are driven by a 6-hp., gasoline engine and the pump is operated by a 12-h.p. 4-cylinder automobile engine. Two 4-yard trucks keep the concrete mixer supplied when the haul is short.

Newark Sewer Tunnel

Heading About 7 Feet Diameter Driven Under Pneumatic Pressure with Permanent Steel Roof Plates; Shaft Lined with Tongue and Groove Sheeting; Concreted Top and Bottom; Air Lock Set in It, and Concrete for Tunnel Lining Delivered by Pneumatic Process.

Section 30, Newark branch intercepting sewer, has 3,310 linear feet of circular tunnel with reinforced concrete lining 12 inches thick and 57 inches inside diameter.

It is located on street lines with the invert about 27 feet below the surface on a grade of about 1 to 1,000. For a length of about 1,400 feet it is located about 4 feet below and generally a short distance to one side of an existing 3 feet 6 inch x 4 feet 10-inch brick sewer in service with which it will be eventually connected by a gate chamber at one extremity of the line. Above the sewer, there are installed under the roadway 6-inch water mains, water service pipes, 2-inch gas mains and 8-inch local sewers and branches all of which are maintained in operation without disturbance.

CONCRETE MIXING PLANT AND AIR LOCK AT TOP OF SHAFT.

The soil encountered is chiefly sand, loam and clay with ground water level at or near subgrade which is sometimes a foot or two above or a foot or two below it. The construction of the sewer involves about 3,000 yards of concrete, and 27,000 pounds of reinforced steel, exclusive of the shaft and gate chamber. The contract calls for the completion of the work in a limited time after the award was made May 10, 1919, and the contractor being allowed to build the sewer by open trench or tunnel methods, elected to use the latter.

The methods have been carefully planned, first class equipment installed, and scheduled progress is being made by the contractor, The North Atlantic Construction Co., that is executing the work under the direction of W. M. Brown, chief engineer of the Passaic Valley Sewerage Commission.

SHAFT EXCAVATION AND BRACING.

The tunnel is now being driven in both directions from a 16 x 18-foot temporary shaft located near the central point of the line. The upper part of the shaft was excavated in the open, in dry soil by pick and shovel, the soil being loaded into a 1-yard steel bucket and hoisted by a stiffleg derrick installed on the surface.

As the excavation progressed, the sides were sheeted with 3-inch tongue and groove wooden planks 16 feet long driven by a light steam hammer suspended from the derrick boom. The piles were driven successively 1 or 2 feet at a time to keep their lower ends 1 or 2 feet below the bottom of the pit as the excavation progressed.

The shaft was braced with 8 x 8-inch timbers and at a depth of about 16 feet below the surface excavation was suspended while interior forms about 7 feet high were built enclosing a 10 x 12-foot rectangle parallel and concentric with the exterior walls.

The space outside the forms was concreted and a concrete floor 2½ feet thick was built on the walls and monolithic with them forming a deck closing the shaft and with a central 36-inch material shaft hole and a 36-inch manlock hole, two 8-inch holes for air pipes, four 4-inch holes for blow lines, two 6-inch holes for high pressure air pipes, and an 8-inch concrete chute hole. The slab was reinforced with 1-inch horizontal and transverse bars 6 and 12 inches apart. After the concrete was sufficiently set, air locks and pipes were installed, pneumatic pressure was applied and the remainder of the shaft to the final depth of 27 feet was excavated by pick and shovel work, the sides being sheeted with 3 x 8-inch horizontal boards with short spacers nailed to the end to separate the successive courses 2 inches. A 2 x 4-inch vertical strip 8 inches long was nailed to the inner surface of each board 3 inches from the end on the 13 foot 8 inch sides of the shaft, to give shoulders affording bearing for the boards on the 15 foot 2 inch sides, each of which was made in two parts with a butt joint at the centre.

As the excavation proceeded the sides of the pit were lined with concrete 12 inches thick, reinforced with vertical and horizontal ¾-inch bars near the inner surface. This concrete, deposited in successive courses of convenient height to underpin the upper parts of the wall, was anchored to the latter by vertical dowels left projecting from the lower side of each successive course and was laid up against the permanent exterior wooden sheeting.

The bottom of the pit was covered with a reinforced concrete floor 12 inches thick bounded to the walls by the vertical reinforcement bars in the latter. Circular holes 7 feet 1 inch in diameter and concentric with the tunnel were molded in opposite sides of the shaft lining, but the exterior wooden lagging was uninterrupted and continuous outside of them.

INSTALLATION OF PLANT.

In the operating house near the top of the shaft, there are installed three Ingersoll air compressors each with a combined capacity of 3,600 feet of free air per minute, which are operated with steam from three locomotive type boilers of 310 h. p. combined capacity. One of the machines suffices to maintain the required air pressure of 5 to 10 pounds in the headings and the other is held constantly in reserve, ready for instant use in case of necessity. At present no high pressure air is required, but either machine can be operated to provide it for running pneumatic tools or other purposes.

Concrete is mixed in a Ransome mixer of ¾-yard capacity, and the derrick is operated by a two-drum American hoisting engine.

The airlock on the material shaft is fitted with an umbrella cover, the domed top plate of which is gasketed and held by a number of pivoted bolts working through slots, that are easily released to provide for the passage of the bucket. The bucket is attached to a hoisting line passing through a stuffing box in the domed cover and thus permits rapid operation of the lock. The manlock is of the ordinary description with hinged doors and, on account of the low pressure, it is operated as rapidly as the air can be delivered or exhausted so that it only requires 2 or 3 minutes to enter or leave the tunnel.

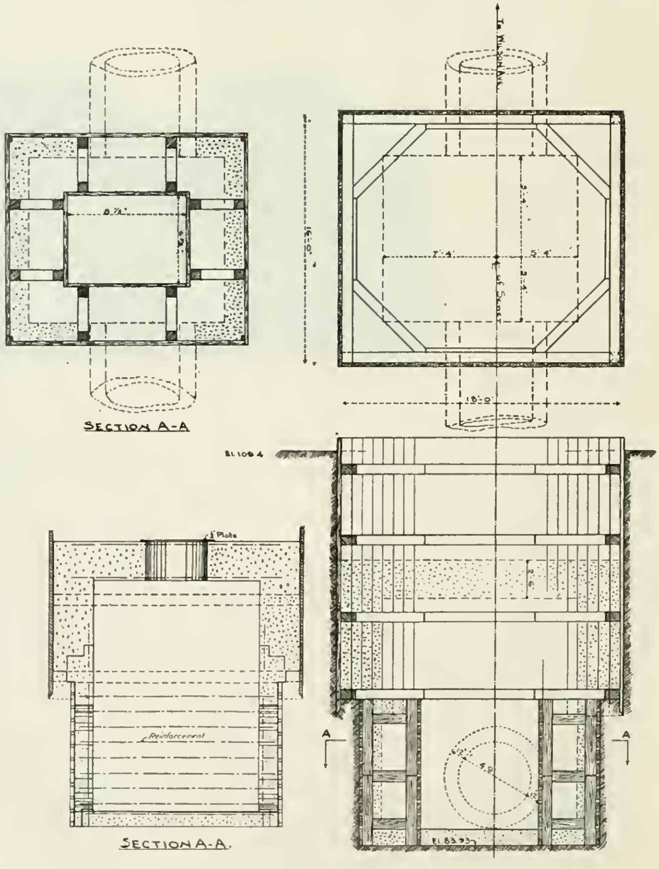
TUNNEL EXCAVATION.

Drifts were started simultaneously in both directions from opposite sides of the shaft where the wooden lagging was cut through and the earth and clay removed with picks and loaded into ½-yard rotary steel dump cars running on an 18-inch gauge service track with 12-pound rails laid on the invert of the finished tunnel. At the foot of the shaft the cars dump into the circular bucket in which the soil is hauled to the surface. On account of the very small dimensions of the tunnel the corners of the standard steel bodies of the dump cars had to be rounded off in order to give clearance for revolving them.

The heading is excavated full size, with the upper part carried a little in advance of the lower part and the neat excavation widened a little at the haunches providing there a horizontal shelf on which are seated the ends of the segmental courses of steel roof plate.

Although the earth is very solid and stands up well with vertical faces when first cut, the contractors are unwilling to take any chances and support the roof close up to the heading with the segmental arch plates provided for in the contract and there designated as permanent reinforcement.

These plates, furnished by the Blaw-Knox Co., correspond exactly to the regular cast iron segments of permanent tunnel linings used in shield driven circular tunnels. They are, however, made of very thin pressed sheet metal with flanges on all sides for bolted connections. They have a uniform width of 12 inches and are about 3 feet long and weigh only about 15 pounds each.



SHAFT SHEETING, CONCRETE LINING, BRACING AND HORIZONTAL CONCRETE DIAPHRAGM FOR AIR LOCK.

The contract provides for the use of these plates if necessary around the entire arch and to a point 1 foot below the springing line on both sides, but where the ground is satisfactory, they are omitted below the haunches.

The segments are assembled from the crown downward on both sides, the centre ones being temporarily supported until the skew back pieces are wedged up on the ledges, by cantilever beams jacked up against the last completed section of arch plates.

CONCRETING.

In order to expedite the delivery of concrete to the headings and to avoid obstructing the very limited space at the foot of the shaft in the tunnel, the concrete is mixed on the surface and delivered from the mixer to a Ransome-Caniff pneumatic machine installed in the upper part of the shaft which acts as an air lock and from which the concrete is rapidly forced through the 8-inch delivery pipe to the steel dump cars, already described, at the foot of the shaft.

The concreting is kept as close as possible to the face of the heading where there are installed two 5-foot sections of standard Blaw steel collapsible forms with removable upper lagging.

SHAFT HEAD HOUSE, AIR COMPRESSOR PLANT AND CONTRACTOR'S SHOPS.

The concrete is dumped from the cars into the lower parts of the forms and shoveled from the cars into the upper parts. The work is carried on continuously with three 8-hour, 17-man shifts per day in each heading, each averaging an advance of 5 feet per shift, or 30 feet in 24 hours.

In each excavating gang there is one foreman at $7.50 per day, two miners at $6 each per day, and 4 muckers at $5.50 each per day.

So far very little water has been encountered in one heading and not much in the other, and the soil has been good and safe except in one heading where a bed of quicksand has been encountered in the bottom that at present comes up about a foot above the invert but had occasioned little trouble.

The Snoqualmie Falls Lumber Co., Washington, occasionally does field work worthy of a contractor for engineering construction when by means of its hoisting engines and equipment of wire hauling ropes and guides, it moves, in a vertical position, trees 200 feet high and 8 feet in diameter that are cut off clear of the stumps and hauled from 10 to 100 feet horizontally before they are lowered to lie on the surface of the ground.

National Department of Public Works

Professor George F. Swain has outlined as follows some of the principal advantages which will be secured by Senate Bill No. 2232 for the creation of a national department of public works:

1. It will conduce to efficiency by co-ordinating in one department and under one head the administration of all works built and operated for the use of the public.
2. It will conduce to economy. There will be either less expenditure or greater result obtained for each dollar expended.
3. It will eliminate rivalry and competition for appropriations between different departments.
4. It will provide a complete organization which can, if necessity requires, be turned to war work or any other emergency.
5. It will provide an organization equipped to do technical work for other departments at their request.
6. It will result in a standardization of specifications and contracts.
7. It will, therefore, eliminate much of the risk and delay which a contractor now has to face in taking a government contract.
8. It will simplify the purchase of materials, machinery, etc., and conduce to economy in such purchases.
9. It will help to bring about the establishment of a budget system.
10. It will serve as a regulator of our national industries, because the Department can speed up its work in dull times and slow down in boom times.
11. It will put us in line with other civilized countries most of which have a Department of Public Works, under a cabinet minister.
12. It will provide means for giving to the officers of the Corps of Engineers of the United States Army a broader experience in construction work than they now have and covering lines more specially connected with the work which they have to do in war.
13. It will help to prove to the world that a democracy can be administered economically and efficiently.

Car Shortage Relieved by Motor Trucks

The car shortage which is beginning to be seriously felt in many parts of the country has already had its effect upon the sales of motor trucks. In August the sales of Mack Trucks alone increased 64 per cent over those for July, and the sales for September continue at the same high rate.

R. E. Fulton, vice-president of the International Motor Company, said: "There is just one solution to our present industrial troubles, and that is the production of necessary supplies on the largest scale possible, and their prompt, thorough and efficient distribution. Through its transportation efficiency and economy, the motor truck is giving material aid in advancing both production and distribution. Reliance on motor trucks will become more imperative with the coming of cold and unfavorable weather."

Mechanical Road Construction

Rapid progress was made in the construction of 20 miles of an 18-foot concrete highway, by the installation of an abundant and well selected mechanical equipment that eliminated a large percentage of hand work and was operated by a well organized force working systematically to a definite schedule that secured a high degree of efficiency. All materials were delivered by rail to elevated storage bins, shifted as the work progressed, and then distributed over service tracks taken up and relaid to correspond with the working progress. Two grading plants and two concreting plants simultaneously completed pairs of sections into which the road was divided.

About 20½ miles of the 18-foot concrete surface of the Lincoln Highway between DeKalb and Geneva, Ill., has been constructed at the rate of nearly 1,000 linear feet per day by contractor J. O. Heyworth, Chicago.

EXCAVATING AND GRADING.

The road was divided into five 4-mile sections consectuively numbered 1, 2, 3, 4, and 5. The new road replaces an old gravel surface road, all of the top of which was removed with cuts made to a maximum depth of 1½ feet and averaging 3,000 yards per mile. The work was done with a single grading outfit and two subgrading and concreting outfits. The former was installed at the end of the line and graded all of section 1 and a little of section 2 before the concreting plants were installed at the extremities of sections 1 and 2, and thereafter kept about 3 miles in advance of the concreting.

A scarifier was used to loosen the most refractory parts of the old surface and the material was dug out and removed chiefly by an elevating grader hauled by 12 horses and loaded into dump wagons that distributed the material along the shoulders. Drag scrapers were provided for light dressing and moving the material for short distances. The men operating the machines and wagons were boarded in a portable camp moved every two miles so that the men had to walk a maximum distance of only one mile in each direction from the camp. The camp was provided with a kitchen, a mess wagon and a bunk tent.

After the grading had been completed, the subgrading equipments which accompanied the concreting machinery started at the first end of sections 1 and 2 and after completing them simultaneously were transferred to the first ends of sections 3 and 4, and afterwards to the middle of section 5, where they operated simultaneously in both directions.

The road bed and ditches were shaped to approximate cross-section by a blade scraper hauled by a steam roller that afterwards finished them accurately enough for the steel side forms to be set true to line and grade. A subgrade finishing machine, rolling on the steel side forms, was hauled along the line by the roller, and after trimming the surface down as closely as possible, was followed by the roller alone, which finished the subgrade ready to receive the concrete.

STORAGE AND DISTRIBUTION.

Sand, gravel and bulk cement were delivered on railroad sidings laid successively to the three storage points, the first and second of which were on the main line of the Chicago and North Western Railway while the third was located at a considerable distance from it transversely.

The first shortage was located close to the railroad tracks and about half a mile from the highway opposite the point where sections 1 and 2 joined. The second storage was similarly located on the opposite side of the highway where sections 3 and 4 joined, and the third storage was located in the middle of section 5, close to the highway, but more remote from the railroad, which at that point is oblique to the highway. Two locomotive cranes operating on a track alongside the railroad track unloaded the contents of the sand and gravel cars with a clamshell bucket, delivering them to open flat-bottom storage bins, or, when there was an excess of material above daily requirements, delivered it to storage piles on the surface of the ground alongside whence the material could be reclaimed and filled into the storage bins if the railroad supply was interrupted. The cement was delivered in flat bottom gondola cars which, like the cement bins, were protected by tarpaulins.

Attached to the bottom of each cement bin, over the center lines of the industrial tracks that passed under it, there were several 15 x 15-inch vertical steel hoppers with a 6 x 6-inch open bottom, projecting from the bin bottom and into the top of the chute so as to concentrate the delivery of cement to the center part of the chute. Vertical pipes, open at the top and bottom, passed through the sides of the hopper and extended above the top of the bin to equalize the atmospheric pressure in the chute when the latter was filled with cement.

The flow through the hopper was controlled by a horizontal sliding steel gate closing against a rubber packing, which prevented leakage. About 2 feet below this gate there was a second similar gate closing the lower end of the chute. The two gates were simultaneously operated by a lever so arranged that if either one was opened, the other was closed, and this simultaneous operation delivered always a fixed quantity of cement fro mthe chute, sufficient for one batch of concrete.

SERVICE TRACKS.

There were provided five miles of 24-inch industrial track in 15-foot sections which was laid under the bin and passed thence to the highway where it branched 90 degrees in each direction to follow parallel with the highway. One branch was at first extended to the beginning of section 1 and the other branch extended only a short distance on section 2 from its beginning adjacent to section 1. Materials were delivered over these branches to the mixers installed opposite their extremities and as fast as the concreting advanced on section 1, the track was taken up alongside the completed portion, loaded on cars, and shifted to a position in advance of the concreting on section 2, where the track was relaid and the process continued until most of the track paralleling section 1 had been laid on section 2.

When sections 1 and 2 had been completed, the storage bins were knocked down, transferred, and reerected opposite the junction of sections 3 and 4 and the industrial track shifted to lead to the beginnings of these sections; and finally, the shifting operations were repeated and the same program carried out for the third position of the storage bins.

Sidings long enough to accommodate a locomotive and train of cars were provided on the industrial track close to the highway, between this position and the storage bin, and adjacent to the concrete plants wherever the latter were located. Besides these a fifth siding was provided at the junction of the adjacent sections where a blacksmith and repair shop was located.

CONCRETING.

Each of the concrete mixers was a four-batch machine with caterpillar traction and an elevator charging skip served by a boom which emptied into it the contents of 2x3½x4-feet wooden batch boxes with bottom flap doors controlled by hand-operated latches.

The batch boxes, loaded in pairs on trains of flat cars hauled by locomotives, were provided with gage marks indicating the required amount of sand, which was first drawn into each when the cars were run under the storage bins. The cars and boxes were then hauled to position under the cement bin and one batch of cement was delivered to each, after which the cars were hauled under the stone bins and filled to the top with stone. Five trains were kept constantly in service, one of them always being loaded at the storage bins while two were in transit and two more were being unloaded at the mixers.

Each concreting gang consisted of 10 men who unloaded the trains, operated the mixers, spread the concrete and operated one mechanical tamping and finishing machine. Two of the men covered the slab with canvas and built dikes for its pondage. With this equipment a progress of about 450 linear feet per day was made by each concrete mixer.

Highway Improvement Rewarded

The Pennsylvania State appropriation of $1,000,000 has been apportioned among the various counties according to the miles of roads in townships of the second class. This mileage is compiled from map surveys made by the township division of the State Highway Department. There is a total of 74,875 miles of township roads in townships of the second class. The distribution is at the rate of $13.35 per mile. Second class townships are not entitled to any part of this reward until they comply with the, State law governing the new system. Lancaster County leads with the maximum of 2,567 miles of road improvement for which the reward amounted to $34,383.80.

A Versatile Paving Mixer

The DuPont Engineering Company, of Detroit, Michigan, used a 1919 Model Smith Paver more than a year for a large variety of services in connection with the construction of the new plant of the Cadillac Motors Company at Detroit, without any breakdown or need of a repair part.

This paver, equipped with a swivel chute, poured all the many column footings, each 8 feet wide, 8 feet long and approximately 8 feet deep. The paver was placed between the rows and poured first on one side and then on the other side by merely swinging the chute, advancing easily and rapidly by its own traction.

After the paver had completed this work it was driven under its own power to another spot where it poured the walls of one of a large tunnel.

It was then taken into the building and was used for grouting in the successive floors and for pouring all of the floor slabs.

It was taken from one story to the next by a crane which hooked onto two cables wrapped around the machine.

Care of Wire Ropes

Wire rope should be carefully unwound from the reel so as to avoid kinks that are likely to injure it very much. The reel should either be placed on an improvised turntable and the rope pulled off, or it should be rolled on the ground leaving the rope in a long straight line. When new rope is led over grooves in old sheaves or drums the latter should be carefully examined to make sure that they have not worn too small at the bottom, in which case they will seriously injure the rope. The rope should be well greased when first received and should be lubricated from time to time.

Multiple Ditching Plant

Excellent results were obtained in excavating right of way ditches with machinery on a very busy railroad line where there were very short intervals between trains when the machines could work.

A train was made up consisting of three pairs of dump cars separated by three flat cars on each of which was mounted an American ditcher machine. The train was hauled by a locomotive that pulled it on to the main line in short intervals between regular trains and permitted the ditchers to work with maximum rapidity filling the adjacent dump cars.

In this way the work was not only done at least three times as rapidly as by the ordinary method of handling a single ditching machine as a separate unit, but the average cost of the latter operation, 18 cents per yard was reduced to 13 cents thus effecting a saving of more than 27 per cent. in the direct cost besides expediting the work and reducing loss through delays. For emergency work it is evident that when several machines are available they can be handled to advantage in batteries.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Separate Bridge Bids—7.

In Clark vs. Beadle County, 173 N. W. R., a contract had been awarded by the county to a bridge company for the construction of six bridges, for which the bridge company had bid a lump sum. The Statute required a separate bid for each bridge to be built. The plaintiff, who himself had bid upon the contract, brought an action as a taxpayer to enjoin the county from paying any money under the contract. The action was not brought until more than two months after awarding of the contract and until after the bridge company had performed much of the work. The Supreme Court held that the plaintiff who knew of the awarding of the contract, was estopped from maintaining such an action. (Supreme Court of South Dakota, July 22nd, 1919.)

Irregularity Does Not Void Authorized Sewer Contract.

In Stickel Lumber Company vs. City of Kearney, 173 N. W. R., 595, it appeared that a special election had been called for the submission to the electors of a prosposition to vote certain bonds, the proceeds of which were to be used to pay for a sewerage system. In anticipation of a favorable result of the election, the City Engineer purchased certain pipe and caused it to be laid. At the election the proposition to vote bonds was defeated. A bill for the pipe was allowed by the city council and a warrant ordered to be drawn, when an appeal was taken to the District Court by an intervening taxpayer. The Supreme Court of Nebraska held that the city was liable, saying in part:

"Even though the statutory requirements as to the making of a contract have not been carried out, if the city authorities are vested with general authority to do the act for the performance of which the materials are supplied and there are no elements of other than fair dealing shown and the city elects to keep the property, there may still be a recovery for the reasonable value of the same . . . In the case at bar, by the Statute then existing, the Mayor and Council were given the power to change the grade of the street and to award contracts for pecfecting such change. Where the Municipal Corporation has the power to make a contract but fails to follow the procedure laid down by the law as to the making of the contract it cannot properly be said to be ultra vires and void, but is merely irregular."

Retained Payment for Pavement.

Hagaman vs. City of Rochester, 185 A. D. 161, Supreme Court, N. Y., Appellate Division, Fourth Department. The syllabus follows: "Where in actions by the transferee of certain funds representing moneys earned by contractors for the construction of pavements and retained by the authorities of the defendant city as security for the fulfillment of the covenants of the contractors to maintain and keep in repair the pavements for the period of ten years, that period having expired, the defendant alleged that the right to the funds had been abandoned and that the moneys, except a small amount which had been paid to the plaintiff, had been applied to the payment of expenses incurred by the defendant in the work of maintenance of the pavements made necessary by the default of the contractors, and under the provisions of the contracts the contractors could only be put in default for failure to make repairs by neglect to make them after written notices by the commissioner of public works were served upon them, either personally or by leaving the same at their places of business or residences or with their agents in charge of the work, it was error for the court to instruct the jury that even though no notices were given of the need of repairs to the pavements, and no notices were given requiring the contractors to repair the same, still by the terms of the contracts the contractors were required to keep the pavements in repair so that if repairs were needed and not made by the contractors, but were made by the city authorities or under their direction, the expenses of such repairs could be taken from the guaranty funds.

"It was also error for the court to permit the jury to find that letters mailed to the contractors if received by those to whom they were addressed, constituted a substantial compliance with the contract for the service of notices requiring repairs, as the members of the firms of contractors were men well known in the defendant city and should at all times easily have been found.

"The letter and spirit of the contract required strict adherence to the prescribed method of the service of notices, and such method was a condition precedent to the right of the city to make repairs at the expense of the contractors.

"Letters calling for repairs to a pavement addressed to a member of the contracting firm, individually, even though served personally, would not be sufficient under the contract to put the firm in default."

Repudiation of Sub-Contract.

Re:—Interstate Const. Co., Ltd., vs. United States Fidelity & Guaranty Co. Supreme Court of Michigan, P. 173—NWR 174. Where a contractor mailed a subcontract, and sent the subcontractor a telegram relating to the subcontract on the same day, the subcontract and telegram were parts of a single transaction and both might be examined for the purpose of ascertaining the agreement of the parties.

Where it was contemplated that work under the subcontract was to commence within a reasonable time after a certain date, the subcontractor having elected to repudiate the subcontract because of the contractor's unreasonable delay in having the piling and foundation in proper shape for commencement of the work by the subcontractor, could show, in the contractor's actions for breach of subcontract, that the changed labor conditions occasioned by the contractor's unwarranted delay would have imposed an extraordinary and unwarranted burden on the subcontractor.

Herring, W. E., has resigned as industrial manageer of the Puget Sound Traction Light & Power Co. and has joined the engineering staff of Stone & Webster.

NEWS OF THE SOCIETIES

March 24-25. NATIONAL WHOLESALE LUMBER DEALERS ASSOCIATION, Washington, D. C. Secretary, 66 Broadway, New York.

March 24-25.—NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

March 24-26. SOCIETY OF INDUSTRIAL ENGINEERS, Bellevue-Stratford Hotel, Philadelphia. Secretary, 327 South La Salle St., Chicago.

March 25. NORTH CAROLINA PINE ASSOCIATION, Norfolk, Va. Secretary, Norfolk, Va.

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secrtary, John M. Diven, 153 West 71st Street, New York City.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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National Federation of Construction Industries.

At the first annual meeting, Chicago, March 24-26, the Member Associations are requested: (1) To confer upon their delegates to the annual meeting power to act in the adoption of amendments to the By-laws; (2) To submit to the Board of Directors, through the Secretary, not later than March 15, 1920, any desired amendments to the proposed By-Laws.

Associations which are not members of the Federation are requested: (1) To send representatives to the annual meeting with power to make application for membership in the name of their association; (2) To furnish credentials conferring upon their representatives the power of delegates as soon as their association shall have been elected to membership.

Individual members are requested to submit to the Board of Directors of the Federation, through the Secretary, not later than March 15, 1920, any desired amendments to the proposed By-Laws.

The Directors of the Federation extend a cordial invitation to all Associations, both member and non-member, having to do in any way with the construction industry, to have present at the annual meeting their secretary-managers, district managers, legal counsels, engineers, traffic managers, publicists, statisticians and other members of their staff.

American Water Works Association

The New York section of the Association has started a drive to increase its membership sufficiently to win the Hill Cup before the close of the contest next June, and has sent out a large number of membership applications. Additional applications may be had from J. M. Diven, secretary, 153 W. 71st Street, New York City.

The Hill Cup is awarded to the section showing the greatest percentage increase in membership during the year. It is now held by the Minnesota Section and is still in the ring, due to their generous offer to have the contest continued although they have won it for three years and could claim permanent possession. New York Section has to date the same percentage growth this year as the Minnesota Section.

American Lumber Association.

Formation of the American Lumber Association by leading wholesale lumber dealers of the United States, is declared to be the greatest lumber organization in the world in scope, capital and business represented. The new association will begin operations the latter part of this month with headquarters in Chicago. Its membership comprises wholesale lumber dealers in all important American cities with selling connections in all parts of the world.

L. Germain, Jr., head of a large concern that bears his name in Pittsburgh, Pa., has been selected as president, and L. R. Putnam, of New Orleans, who now resigns as director of advertising and trade extension for the Southern Pine Association, has been appointed manager. Mr. Germain also is president of the National Bureau of Wholesale Lumber Distributors, which was formed to serve the lumber needs of the United States government during the war.

According to Mr. Putman, who made the announcement of the formation of the wholesalers' association, the same style of organization that handled the lumber situation for Uncle Sam during the war, in the new association is enlarged in scope to meet the demands of world trade and to give the lumber consumer the same benefits that were enjoyed by the government in war times.

In the official announcement the purposes of the association are stated to be to standardize the buying and distribution of the enormous volume of wholesale lumber business; to enforce a rigid code of business ethics among lumber wholesalers; to systematize distribution so that no part of the market shall be crying vainly for lumber while other parts of the market are glutted, and to devise means for eliminating the present enormous wastage in the lumber business.

"The American Lumber Association will have nothing to do with the naming of prices on lumber, which will be fixed by the manufacturers as at present, but it is designed to perform a service for the world in peace that was performed for the nation in war by the National Bureau of Wholesale Lumber Distributors." Further purposes and plans as set forth in the announcement are as follows:

"Marked reduction in the cost of handling America's lumber output, which a recent nation-wide survey has shown to cost manufacturers more than $50,000,000 annually is expected to result from the work of the new association. In the United States today there are in excess of 40,000 saw mills in operation, each mill maintaining its own selling organization and having its own representative in the field. With the creation of a central sales force by the new association much of this huge annual expense will be eliminated from America's lumber business and efficiency will be increased. The central offices in Chicago will act as a lumber clearing house for the country's leading wholesalers.

Chamber of Commerce of the United States.

The eighth annual meeting at Atlantic City, April 27 to 29, will be an Increased Production Convention. The general subject of increased production has been divided up in the program for the convention into sub-subjects. The first to be taken up will be the government in relation to production. Under this heading will be considered anti-trust legislation and taxation.

The second general subject to be taken up will be transportation in relation to production. This will include both land and water transportation. One of the chief causes of lack of production just now, it has been pointed out, is the general shortage of railroad equipment. One authority estimates that the country is short at least 200,000 box cars and all lines of industry have felt the shortage.

International finance and its relation to world production will be discussed both from the financier's and the businessman's point of view. The chamber has just expressed its willingness to name delegates to an international financial conference under limitations outlined by the Treasury Department. Lack of means of financing European industries is a decided factor in retarding production in many of the countries of Europe.

One general session of the convention will be given over to agriculture in relation to production.

Another important general subject will be the relation of labor to production. This will be approached from both sides, the employes' viewpoint being presented by a representative of the American Federation of Labor and the employer's by a business man.

Besides the general sessions there will be held group meetings, divided as along the great divisions of industry.

Louisiana Engineering Society.

The regular meeting of the Louisiana Engineering Society was held in New Orleans, March 8. Marcel Garsaud, representing a committee from the State Board of Engineering Examiners, introduced a resolution leading to the endorsement of the society of the amendment to Act No. 200, 1914, relative to the practice of civil engineering and surveying in Louisiana.

Drainage Conference.

The Third Annual Drainage Conference of the University of Illinois was held at Urbana, Ill., March 16-18. Drainage officials, owners of low lands, agriculturists, engineers, contractors, attorneys, and business men from all parts of the state were in attendance to discuss the importance of the reclamation of the overflowed lands, and ways and means for accomplishing its reclamation.

Engineering Council.

In December, 1919, Engineering Council created a Military Affairs Committee to consider the relation of engineers to the future military establishment and activities of the United States. The membership comprises civilians as well as ex-officers of many of the services of the Army and Navy, men of all the important branches of the Profession of Engineering. This committee recommends the training of the entire youth of the nation and the establishment of organized reserves are indispensable provisions for national defense. With an adequate, organized citizen force, so that a minimum of professional soldiers is required, that maximum protection is afforded with a minimum of expense.

Women's Municipal League of the City of New York.

The chairman of the special committee on streets, Mrs. Julius Henry Cohen has addressed a letter to Mayor Hylan protesting vigorously against the present antiquated methods and machinery of the Department of Street Cleaning which, she contends, should be entirely motorized and, in view of the great labor shortage, should be supplied with more automobile sweeping and flushing machines, more snow plows, and more machines to propel the plows. She also pleads for the conservation of the idle garbage disposal plants at Barren Island and on Staten Island and suggests that garbage reduction plants be installed in the different boroughs for the immediate disposal of the contents of dump carts and the reduction of hauling expenses.

Standard Engineering Salaries Recommended.

The Twin City Chapter of the American Association of Engineers has submitted a compensation report to the city of Minneapolis which contains recommended salaries for all grades of engineers employed by the city. The recommended salary for the city engineers vary from $7,500 to $15,000 per annum, that of the assistant city engineer from $5,000 to $7,500. Sewer engineer, bridge engineer and engineers of construction, streets, etc., are recommended for salaries ranging from $3,000 to $5,000 per annum. The range for assistant is from $2,400 to $3,600.

PERSONALS

Gregory, Charles E., deputy chief engineer North Jersey Water Supply Commission, died Feb. 21.

White, Edward A., general superintendent of the White Paving Co., Chicago, died Feb. 18.

Martin, W. E., treasurer of the H. K. Porter Co., Pittsburgh, died Jan. 12

Bessey, John M., has been appointed general manager of the Employers' Mutual Insurance Co., New York.

Wheelin, James E., has been appointed secretary of the Employers' Mutual Insurance Co., New York.

Burbank, George Barker, consulting civil engineer, prominent in Niagara Falls electric power development, died of pneumonia at his home at Niagara Falls, N. Y., Feb. 29.

Shurick, A. T., mining engineer, recently identified with the **Coal Trade Journal** and formerly with **Coal Age,** has become associated with F. C. Thornley & Co., Inc., 31 West Forty-third street, New York. The company designs, constructs and organizes for operation, installations for the mechanical handling of materials. It also acts in a consulting capacity in the valuation and appraisal of properties and preparation of engineering reports.

Simmons, Maj. E. B., has been appointed chief engineer of the Willite R. C. Co., of Indiana with offices at Ft. Wayne, Ind., after April 1st. Maj. Simmons served with the 302nd Engineers, 77th Division and at the time of the armistice was in command of the 2d Bn. in the Argonne.

Reeves, Guy A., has been elected V. P. and general manager of the Willite R. C. Co., of Indiana with offices at Indianapolis and Ft. Wayne, Ind. Mr. Reeves has been connected with the Asphalt Sales Dept. of the Texas Co., for many years.

Howe, Wm., of Chicago, has joined the Willite R. C. Co., of Indiana.

Hull, Noah E., has been appointed city engineer of Kendallville, Ind.

Goldsmith, William, formerly construction engineer with the City of New York, has been made president and general manager of the Riverdale Construction Co., Inc., New York.

Weatherford, J. D., building inspector, Phoenix, Arizona, has resigned to undertake general contracting.

Brillhart, D. H., and Brothers, G. R., have formed the Brillhart-Brothers Co., Inc., engineers and contractors, Bethlehem, Pa.

Turner, George F., has been appointed city engineer, Youngstown, O.

Gilmore, J. H., has entered the firm of Mish & Netherland, engineers and contractors, Pittsburgh.

The Armstrong Engineering Co. has been organized at Taylorsville, Ill., with H. G. Armstrong, R. R. Simpson and Judson Rucker, as members.

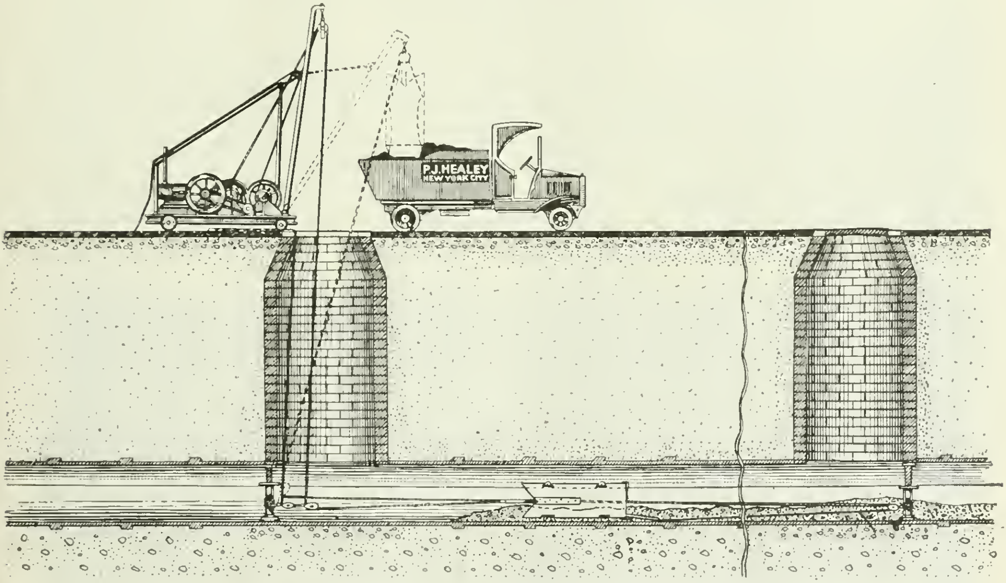
Hayes, Harry R., commissioner of public works, Utica, will resign that position to become manager of the Hayes Engineering Service, Utica, specializing in municipal utilities, city planning and engineering valuation.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

Healey Sewer Cleaning Machine.

Machines invented, manufactured, operated and sold by P. J. Healey are designed to remove sediment and all kinds of obstructions and to thoroughly clean any shape or size of well built sewer, no matter whether it is filled with water or is dry, and without the necessity of men entering the sewer. It thus enables the sewers to be maintained with much greater safety, economy, and efficiency and eliminates the danger, sometimes serious, of working in the very unsanitary conditions encountered in a sewer where often the gas is poisonous and sometimes causes fatal results.



CLEANING MACHINE OPERATING IN PIPE SEWER. BUCKET IN FILLING POSITION.

The apparatus is simple and positive in its operation and consists substantially of a hoisting engine and derrick mounted on a steel truck and easily moved from point to point in the street where it is located at a convenient manhole and operates a special bucket-shovel that it drags from manhole to manhole, excavating and removing all obstructions and hoisting and dumping them to trucks spotted near the derrick.

The special bucket is mounted on wheels and provided with friction rollers and with devices for opening or closing both front and rear ends. The front end door when opened, drops to a horizontal position with the lower edge resting on the sewer invert and acting as a shovel or scraper that excavates the sediment or other obstructions in the sewer as the bucket is pulled forward by a line attached to the cutting edge of the scraper, passing through a snatch block secured to a brace installed in the forward manhole and returning to a second snatch block secured to another brace installed at the derrick manhole and thence passing to the derrick boom and hoisting drum by which the bucket is hauled from the derrick manhole to the forward manhole, filling itself en route. When filled, the bucket is drawn back to the derrick manhole by means of a line from the hoisting engine passing down the derrick manhole and attached to a bridle connected to the scraper so that tension on it closes the forward end of the bucket.

Arrived at the bottom of the manhole, the hauling line is automatically tripped so as to become the hoisting line, and elevate the bucket above the surface where its contents are dumpd into the waiting truck. The bucket is lowered and the operation is automatically repeated.

The apparatus is operated by two men and the outfit consists of a 3½ h. p. gasoline engine, double drum hoist, and pipe frame derrick mounted on a truck and equipped with 500 feet of ⅜-inch wire cable, 50 feet of release rope, and the necessary braces, shackles, sheave blocks and tool box. When provided with 8-inch, 10-inch, 15-inch, 18-inch and 22-inch buckets, the equipment is adequate for cleaning all sewers from 8 inches to 6 feet in diameter. For larger size sewers, suitable equipment is furnished. With this machine, an 8-foot sewer in Buffalo was cleaned of 5½ feet of mud, gravel and boulders under 7 feet of water.

Building Erection.

The R. F. Jones Co., Hartford, Conn., has been incorporated with $50,000 capital stock.

Incineration of Garbage, etc.

The destruction of city refuse including garbage, street sweepings, dead animals and waste of all kinds, except ashes, at temperatures of 1,500 to 2,500 degrees is accomplished by the B. E. E. semi-producer type with waste furnace manufactured by the Chicago Incinerator Co. that is designed to utilize the fuel value of the waste for making steam. An analysis of the subject and descriptions and illustrations of the construction and operation of these furnaces with examples of their application for various purposes are given in a small pamphlet recently issued by the manufacturers.

Adams Road Machinery.

The road building and maintenance machinery manufactured by J. B. Adams & Co. and described in general catalog No. 20, which illustrates a brief history of road graders the special advantages of the Adams leaning wheel graders that have a toggle joint axle attachment, adjustable in proportion to the amount of the load to prevent side slipping, reduce friction, offset lateral earth pressure and move the maximum amount of dirt with the least power.

It also illustrates graders with blades of from 6 to 12 feet long with scarifier attachment and steerable engine tongue, road maintainers, road patrol scrapers, three-way drags, peerless drags, plows, drag scrapers, fresus scrapers and wheel scrapers.

Lee-Courteany Pumps.

The Lee Courtenay Company, manufacturer of centrifugal pumping machinery, issues in Bulletin H-4 a catalog, description, illustrations and tables of double suction single stage pumps, and single suction multiple stage pumps suitable to various kinds of continuous and intermittent heavy duty. The bulletin describes the manufacture, design and testing of the pumps, shows various types and sizes installed for different services, and gives tables of their h.p. and efficiency. Bulletin S-5 illustrates pumps, most of them of large size, installed in various parts of the country for important service among which is one designed to deliver 5,000 gal. per min. against a total head of 40 ft. Another one in the Chicago City Water Works is designed to deliver 200 gal. per min. under a 460-ft. head.

Lidgerwood Manufacturing Company

This company will, at the National Marine Exposition to be held in the Grand Central Palace, New York, April 12 to 17, exhibit at booth 43, in charge of E. J. Boynton, two types of their standard reverse valve cargo winches. They have installed a compressed air outfit, and the winches will be operated, and an actual demonstration made both of the hoisting ability of these winches and the extreme simplicity of their control. Over 6,000 of these winches have been built and installed.

Steam Tables.

The Wheeler Condenser & Engineering Co. announce the publication of the 1920 (fifth) edition of "Steam Tables for Condenser Work." This is the fifth edition. The pressures below atmosphere have been especially calculated for this book by Prof. Marks. The book gives the properties of saturated steam from 29.8 inches vacuum to atmospheric pressure in increments of tenths of an inch. The vacuum in inches of mercury is referred to a 30-inch barometer. A complete table is also given of the properties of saturated steam above atmospheric pressure.

The book tells how to make measurements by means of the mercury column and barometer. It gives constants and tables for making corrections. It gives the correction to be made for relative expansion of mercury and brass scale, etc. It is a very handy book and of a size that can be carried around in the vest pocket.

Birch Pump Valves.

The Birch-Hintz Manufacturing Co. recommends the use of the Birch pump valves to increase valve area and plunger speed and eliminate valve slippage, thereby increasing pump capacity from 10 per cent to 25 per cent.

Trailmobiles.

These are trucks without motors to be hauled behind trucks, passenger cars or tractors. Their use greatly increases the amount of freight one truck driver can move in a given time and enables a lighter, less expensive truck to do more work than a heavy one, or a small passenger car to do as much hauling as two or three teams under certain conditions. The trailmobile chassis is made in long and short lengths both for 1-ton and 1½-ton loads.

United States Civil Service Examinations.

Examinations will be held April 20 for vacancies in the office of the Chief of Transportation Service, War Department, for duty at Washington, D. C., and throughout the United States, as Marine Engineer, Mechanical Engineer and Electrical Engineer. The registers of eligibles will be divided into Grade 1, $2,400 to $3,000, and Grade 2, $3,000 to $4,000 a year; minimum requirements for each grade being as follows:

Apply for form 2118.

A vacancy in the Engineering Department at large, Florence, Ala., $4,200 a year.

The duties of this position require general familiarity with the design of all classes of equipment of a steam electric or hydro-electric power plant with detailed knowledge of generators, transformers, switching and control apparatus and transmission lines. The appointee must have sufficient knowledge of architectural engineering to design the structural, heating and other features of buildings, and a working knowledge of hydraulic engineering as applied to turbine design and operation. He must be able to handle efficiently a force of draftsmen and to supervise and direct construction operations. Apply for form 1312.

Examinations will be held March 30 for Junior Construction Engineer, Junior Designing Engineer and Junior Marine Engineer, for the design and construction of wood, steel and concrete vessels, to fill vacancies in the office of the Chief of Transportation Service, War Department, for duty at Washington, D. C., and throughout the United States at $1,800 to $2,400 a year. Competitors will not be required to report at any place but must apply for form 2118. Vacancies in positions requiring similar qualifications, at this or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. Both men and women, if qualified, may enter this examination, but appointing officers have the legal right to specify the sex desired in requesting certification of eligibles.

Applicants should at once apply for forms, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R.

Applications should be properly executed, excluding the medical certificate, and must be filed with the Civil Service Commission, Washington, D. C., with the material required, prior to the hour of closing business on March 30, 1920.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, MARCH 27, 1920 No. 11

Repaving Granite Block Streets in New York

A large area of worn granite blocks replaced by new blocks on a new concrete base in the Borough of Manhattan during 1919. The old blocks were not recut and although only very slight grading was required, the cost was about 59 per cent greater than for similar work done in 1916.

During 1919, there were relaid in New York City, in the Borough of Manhattan alone, more than 179,000 square yards of standard granite block pavements. New blocks replaced the worn old blocks, not because the latter were worthless, but because it was deemed inadvisable to obstruct traffic by any attempt to recut them on the street and it would have entailed prohibitory delay and expense to haul them to a distant cutting yard and back again. In localities where it is permissible to recut the blocks at the same place where they are removed and relaid, thus eliminating extra handling and transportation, a considerable economy may be effected by using the old blocks, as is done in some places in the Borough of Brooklyn.

PLACING GRANITE BLOCKS WITH A HOOK HAMMER AND WITH A STRAIGHT HAMMER.

DELIVERING HOT JOINT ASPHALT, MIXED WITH HOSE IN SERVICE CART.

The new blocks are of good quality, hard, uniform stones, carefully inspected by city officials at the quarry or as unloaded. Except between car tracks where they are a little larger, the dimensions must be 6 to 10 inches long, 3½ to 4½ inches wide, and 4¾ to 5¼ inches deep. They are dressed so that the head of the block has no depression greater than ¼ inch, and so that the side faces will make joints averaging not more than ⅜ inch wide at the top, a distance that may increase to ½ to ¾ inch at the bottom.

PREPARATION OF BASE.

The old granite blocks are barred out by hand, by a gang of 15 or 20 men using crowbars 5 or 6 feet long, and loading the blocks directly into automobiles or horse-drawn trucks for immediate removal by the contractor, who generally finds for them a good market at $25 to $30 per thousand delivered at the dock.

The same gang breaks up the old concrete base, about 6 inches thick, using for the purpose, ordinary steel crowbars and special levers, 12 to 14 feet long, that are made from 4-inch oak timber tapered from a width of about 4 inches to a width of 6 inches at the lower end that is rounded to a chisel edge and bound with steel to protect it when forced under the edge of the concrete. These levers are operated with a paving block for fulcrum near the lower end, and raise the edge of the concrete base slab, which is then readily broken up by sledging into pieces of one-man size that are hauled immediately to the dumps by horse-drawn trucks. About 300 yards per day of granite pavement and concrete base can be ordinarily removed by one of these gangs.

After the removal of the old concrete base, the light excavation of 1 or 2 inches, necessary to bring the surface of the ground to the required subgrade, is done with shovels and light picking, the surplus earth being loaded into horse drawn trucks and hauled to the dumps. The grade is determined from the curb which is usually set in advance, and elevations are measured every 10 or 12 feet from traverse lines stretched from curb to curb. The surface of subgrade is made to conform to the pavement crown, and is finished with an accuracy of about half an inch.

HEATING JOINT ASPHALT IN PORTABLE TANK.

Usually, the grading is completed for an entire city block before the stone and sand are delivered on it by trucks and dumped in piles convenient for shoveling into the hopper of the mixer, whose wheels usually advance on two rows of longitudinal planks laid close to the center line of the street.

The exact level of the upper surface of the concrete is referred to elevation stakes, driven in advance by the foreman and verified by the inspector. The concrete is carefully shoveled and raked to approximate surface and finished by compacting with square tampers weighing about 20 pounds each, or by means of a wooden tamping template 3 inches thick, which reaches half way across the street and is operated by two men. This method is considered to give better results than the 20-pound tampers, but as it is also harder work and labor is very independent, the other method is sometimes accepted almost as a matter of necessity. A gang of about thirty men, operating a single concrete mixer, will average about 600 square yards of concrete base per 8-hour day.

LAYING GRANITE BLOCKS.

The granite blocks are laid by a gang of six to eight pavers and three or four rammers, who set and level them in a bed of cement mortar 1 inch thick. The mortar is made of one part cement and three parts fine aggregate, thoroughly mixed dry and then slightly moistened, by two men working with shovels on a mortar board and delivering it in wheelbarrows just in advance of the pavers. About 1 cubic yard of mortar is required for 50 cubic yards of pavement surface.

Sand is heated in the street, often on a 10 x 10 foot steel plate supported on paving blocks, with a space beneath in which is maintained a wood fire. The pavers work both with hook hammers and straight hammers. Many of them are Scotch, who generally prefer to stand facing at right angles to the line of blocks being laid and using a light hook hammer, a method which is considered to give better line and which enables the hook to be used to lift the stone from the pile and place it on the mortar bed thus reducing the labor. This method is more popular in Philadelphia than in New York, where most of the pavers stand squarely facing their work.

As soon as they are set, the blocks are well rammed to exact height and level, with a standard cylindrical rammer about 3 inches in diameter and 3 feet long with a large semi-circular handle on each side. The lower end consists of a 50 or 60-pound solid casting. After the blocks have been rammed and inspected, the rammers remove defective blocks and set new ones in their place with tongs, straighten out courses and fill in sand cushions to raise low blocks and ram them again to make the finished surface satisfactory to the inspector. The actual ramming occupies perhaps one-third of the rammer's entire working time.

The asphalt for the joints is heated in movable steel tanks with grates underneath, on which fires are maintained with scrap wood. A barrel of solid asphalt is placed on top of the tank and the heat from the fire below warms it sufficient to permit it to soften and flow into the tank, thus keeping it replenished as the hot asphalt is drawn through a valve in the bottom into a carrier. It is usually found convenient to operate two heating tanks together so that one may supply hot asphalt while the asphalt is being heated in the other, and thus avoid any interruption of the work.

The hot asphalt at a temperature of between 300 and 400 degrees is drawn into two-wheel concrete carts or similar carriers, in which are placed equal volumes of paving cement and hot dry sand. The contents of the carrier are thoroughly mixed by hand with hoes and distributed by men, who wheel the carriers to a point near the open joints and dump the filler on the surface of the paving stones, over which it is spread and flushed into the open joints by one man with a squeegee. Another man is required to wheel the hot sand, and another to attend to the fire under the asphalt tank. This method of applying the joint filler is considered to be much superior to the old way of pouring it directly from a spouted kettle, an operation which invariably left voids in the joints. Usually the entire width of the street from curb to curb is paved and finished in one continuous operation, unless the street is divided by a car track, in which case the pavement each side of the track may be done separately, thus sometimes allowing traffic on one side of the street while the other side is closed.

Although the car companies are responsible for paving between their track rails and 2 feet each side of them, the city usually paves the 2 feet and charges the company for the work.

EXCELLENT ALIGNMENT OF RESURFACED GRANITE

This work is all done by contract at an average total cost of $7.02 per square yard in 1919, as compared with $4.41 in 1916.

The work is in charge of C. M. Pinckney, chief engineer, and R. A. MacGregor, division engineer, Bureau of Highways, Department of Public Works.

Gunniting Deteriorated Wood Piles

In a railroad trestle extending beyond shore line the four-pile wooden bents were considerably deteriorated below the high water line and have recently been reinforced and protected by cement mortar applied by the gunnite process.

A mixing machine, cement gun, and supply of sand and cement were installed on a flat car followed by another flat car equipped with motor driven air compressor, pressure tank and fresh water reservoir. The gunnite was applied in a thickness of about 1/16 inch to 8 inches dependent on the condition of the piles, and wherever large holes had been eaten by marine borers they were covered by wire netting and the piling was brought up to normal size and in all cases was protected up to above high water level. Short piles were treated at the rate of almost one pile per minute and after 7 days it was difficult to break the gunnite even in the thinnest places with continuous pounding. The work was executed by a gang consisting of 1 man that handled the sand and operated the motor, another that handled the cement gun and served as conductor of the train, two men to feed sand and cement to the mixer, one man delivering the mixture to the gun and one man to operate the gun, besides a machine tender and a helper, and three men to handle the hose and nozzle.

Combined Water Works and Electric Plant

By A. K. Kennedy*

The Rockport, Indiana, Water Works Company Operates an Electric Plant by Steam Power and Pumps Water Partly by Steam and Partly by Electricity. The Combination of Utilities in One Plant Makes for Economy.

For twenty-five years we have been operating a combined steam and electric pumping and electric light plant and find the combination very satisfactory. We get our water supply from four 8-inch wells driven 85 feet into an old gravel bed of the Ohio river, so that we have a natural filtration of the river water. Three of these wells are operated by Cook steam heads, and one is electrically driven by a 10 h. p. motor. The last pumps direct into the distribution system, and the three steam driven pumps discharge the water into a reservoir at the pumping station. This reservoir has a capacity of 250,000 gallons and is held in reserve for fire purposes. We have two duplex pumps which draw from this reservoir and deliver into the distribution system. For fire pressure, 20 to 100 pounds, we cut off the water tower and pump direct to the mains. We have 350 h. p. boiler capacity, equipped with shaking grates and automatic dampers.

Our electrical equipment consists of three engines, an 80 h. p. Skinner, a 200 h. p. Skinner, and a 250 h. p. Hamilton Corlis. There are three three-phase generators, 60-cycle, one 100 k. v. a., one 125 k. v. a., and one 150 k. v. a. We give continuous service for lights and motors and have our plant pretty well loaded.

The principal advantages of a combined water and lighting plant are as follows:

1. One building,
2. One sidetrack for coal,
3. One set of engineers,
4. One general manager,
5. One office force,
6. One crew of workmen that do both plumbing and electrical wiring.

These six conditions eliminate a vast amount of unnecessary duplications of physical and economic functions, and all contribute to make a combined plant successful. I have engineered and planned combined plants at five places in Indiana, all of which are successful.

It is not necessary that the water supply should be at the electric station, but it may be located at any distance and operated successfully from the electric station. At one of the places named above, a 10-inch pipe brings the water from an impounding reservoir by gravity to the pumping station. At another, triplex pumps are operated five miles distant from the power plant.

In many cities and towns where the water works are owned by the city and the electric plant by a company the city can contract with the electric company to have the pumping done much cheaper than the city can do it.

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* Secretary and Treasurer of Rockport Water Works Company.

Hetch-Hetchy Water Supply—III[*]

Description of $6,000,000, 112 billion-gallon impounding and storage reservoir with arch dam 400 ft. high at an elevation nearly 3,500 feet above the city of San Francisco, which it supplies. Exploration and borings at site. Clear-forest land, installation of sawmill, construction of headquarters offices, camps and shops. Road building and diversion tunnel.

The Hetch Hetchy Reservoir to store water for a supply of San Francisco will be formed by the clearing of about 2,500 acres of wild forest land and the construction of a cyclopean concrete impounding dam of the arched gravity type that will at first be built about 300 feet high from the lowest part in the foundations to the crest, about 600 feet long, 300 feet thick at the base and 15 feet thick at the top at roadway level, containing about 370,000 yards of concrete. Later the dam will be raised to nearly 400 feet, higher than that of any dam in the world yet built. Preliminary construction operations were commenced at the site in 1916, when about $150,000 was expended on this work. Up to date the total outlay in this locality has been $35,000 and it is expected that the reservoir will be completed in 1922 at a total cost of about $6,000,000.

GENERAL DESCRIPTION.

The spillway lip will be at elevation 3,720, which is 220 feet above the natural low water surface elevation in the river. The temporary initial spillway is to be of the siphon type, discharging over the downstream face of the dam. The time allowed the contractor for building this structure expires January 28, 1922.

The present contract includes the complete foundation below stream level for the ultimate dam. When it becomes necessary to add to the reservoir capacity developed by the initial dam, the dam will be brought up to its full ultimate size by adding a thickness of 80 feet on the downstream face and building it up 85 feet higher. This will make available 80 feet additional depth of reservoir, making the lake 300 feet deep at the dam. The crest length wil be about 900 feet, and the thickness at the crest 25 feet. The spillway will be a channel around the top of the dam, at elevation 3,800.

The ultimate dam will contain about 625,000 cubic yards of concrete.

The reservoir created by the initial dam will have a capacity of 66,000,000,000 gallons, or 202,000 acre-feet, which ultimately will become 112,000,000,000 gallons, or 343,000 acre feet.

The principal quantities involved in the initial dam contract include: Excavation below stream level, 77,000 cubic yards; excavation above stream level, 60,500 cubic yards; cyclopean masonry, 300,200 cubic yards; concrete not included in cyclopean masonry, 69,500 cubic yards.

The reservoir is located on the head waters of the Tuolumne River in the Sierra Nevada mountains about 150 miles east of San Francisco and where the bed of the river has an elevation of 3,500 feet above the sea.

Although the water-shed of the Tuolumne River, extending about 40 miles above the dam, is largely composed of mountains, chiefly of granite formation with little or no earth covering, the valley of the river immediately above the dam was in places densely wooded. At the dam site the valley narrows to a gorge about 140 feet wide at ordinary low water level, elevation 3,500 and 720 feet wide at the elevation of the crest of the proposed main dam, elevation 3,812.

PRELIMINARY OPERATIONS.

Reconnoissances, surveys, geological indications, and the preliminary engineering reports indicated that at the dam site, the maximum depth of bed rock below the river bed was about 40 feet. This assumption was disproved when wash borings, made through the gravel and clay in the river bed, were carried to a depth of more than 75 feet without reaching the bed rock in some places. It was therefort decided to provide for excavating a very deep foundation pit reaching everywhere to bed rock for the permanent structure, and to take suitable precautions against undermining in the construction of the much shallower foundations of the temporary diversion dam.

EXPLORATIONS.

The Board of Public Work advertised for bids to be received in December, 1916, for making core borings at Hetch Hetchy dam site, but no bids were submitted and the work being re-advertised, proposals were received and opened on January 5, 1917, and a contract for about 1,900 linear feet of borings in the river bed and slopes was made with the International Diamond Drill Contracting Co. for estimated price of $14,675.

The borings were completed within 120 days after the date of the contract and furnished data concerning the character of the geological formations on which the plans for the structure were completed and construction contracts were awarded.

These borings indicated a maximum depth of 75 feet below the river bed to the surface of sound rock and showed that the character of the rock was generally solid granite overlaid by disintegrated rock and broken stone and some earth and sand. The appearance of the rock indicated a stratum of very hard dense material suitable for foundations and these indications have been confirmed as the rock has been exposed by subsequent excavation.

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[*] Part I.—154-mile aqueduct and auxiliaries for ultimate delivery of 400,000,000 gallons daily to San Francisco at estimated cost of $45,000,000. Preliminary work, $2,000,000, including construction of $2,000,000 railroad, 68 miles long. PUBLIC WORKS, March 6; page 165.

Part II.—Auxiliary 4,000 hp. hydro-electric power development with impounding dam, storage reservoir, improved river channel canal, flume and tunnel, aqueduct and steel penstock built in the Sierra Nevada mountains at a cost of $690,000 to facilitate construction of main reservoir and 18-mile aqueduct tunnel under high mountains. PUBLIC WORKS, March 20; page 203.

CLEARING.

It was required that the entire reservoir area should be clear of trees and brush before water for domestic purposes was impounded, and the specifications provided that all standing trees, brush and shrubs should be cut down and used for sawlogs and cord wood, or burned. Oak, cottonwood, fir, pine and willow were cut and piled as cord wood at a price of $2.95 per cord. All soft wood including cedar, yellow pine, sugar pine and red fir more than 6 inches in diameter at the butt were classed as sawlogs, cut into lengths of 16 feet or more, peeled and stored on cedar skids in piles of 5, 10, 15 or 20, at a cost of $2.20 per 1,000 feet to be stored until the construction of the dam is begun, when they will be sawed and used for forms, buildings, etc.

Soft wood less than 6 inches in diameter at the butt, or otherwise unsuitable for sawlogs, was cut into cord wood in the same manner as the hard wood at a price of $2.45 per cord. In this way about 1,500 acres have been cleared. This involved an expenditure of about $30,000 for contract work in clearing the site up to 3,500-foot contour and work done by day labor at a cost of about $20,000.

MUNICIPAL SAWMILL CUTTING TIMBER FROM HETCH-HETCHY VALLEY FOR CONSTRUCTION PURPOSES.

CANYON RANCH SAWMILL.

A sawmill was located on property owned by the city in Canyon Ranch, grading was commenced in April, 1915, and timber was felled and hewed for a part of the mill building which was later completed with timber sawed in the mill. Equipment for the mill was purchased for about $13,000 and hauled 50 miles to the site from Chinese, the nearest point on the Sierra railroad.

The mill was operated continuously during the summer of 1916, making a product of 1,600,000 board feet of lumber and surfacing a considerable quantity of lumber, and has since been operated as required at an average cost of about $30,000 per year.

The daily 8-hour shift capacity of the mill is about 15,000 feet of sawed and surfaced lumber. About 4,000,000 feet of lumber from the Canyon Ranch has been sawed. The lumber and timber was used for all sorts of construction purposes, camp buildings, and for any permanent use for which it was suitable.

As the 4,000,000 feet thus derived was inadequate, the city made an arrangement with the department of the interior by which it acquired the right to cut 4,000,000 more feet of timber from selected trees standing on government land near the sawmill. These trees were so selected that they were taken from scattered positions in a wide area and did not denude any portion of the land or impair its picturesque appearance. The work was facilitated by the use of two logging road engines purchased for about $2,500 each.

CAMP AND FACILITIES.

The construction of camp buildings at the dam site was commenced in Sept., 1915, by building a 120 x 40-foot dining room, bunk houses, wood house, oil house, meat house, hospital, cement warehouse, shops, store houses, and various other buildings, all of a substantial type of wooden construction and provided with water supply, drainage and sanitary system, light and heating apparatus.

The camp was located on a beautiful plateau 400 feet above the floor of the valley in a location, which, originally a mosquito breeding swamp, was so thoroughly drained that it became very healthy, and will probably be maintained as a summer resort after the construction work is completed.

The main office building, serving as headquarters for all work in Tuolumne county, was built at Groveland, a village about 41 miles from the dam site. It is a two-story frame structure with rooms for offices, drafting, blue-printing, and living quarters with a steam heating plant. The adjacent warehouses were built for about $4,000, and a machine shop was built and equipped there for about $23,000.

HIGHWAYS.

Various local roads at and around the dam site, aggregating about 5 miles, were built.

A new road, 11 miles long, was also built from the Hetch Hetchy valley to Lake Eleanor which was necessitated by the construction of the impounding dam. It has a 10-foot road bed and 12 per cent maximum grade and climbs the steep cliffs by a series of switchbacks rising to an elevation more than 5,300 feet.

A road nearly 1 mile long, built on a 10 per cent grade from the camp to the Hetch Hetchy valley trails was built from the camp to and around the dam site, and a tramway was built from the Early Intake power house to the Hetch Hetchy railroad, about 3,800 feet distant, at a cost of $20,000. A trail was also made around the Hetch Hetchy reservoir above the flood line and many small branch roads were constructed for the convenience of contractors hauling materials for the dam and tunnel construction. These projects involved an outlay of about $50,000.

At the commencement of operations, the Hetch Hetchy valley was accessible only by trail and before the construction of the railroad access to it was provided by a new road 9 miles long built by the Utah Construction Co. at a cost of about $180,000. This road had a 22-foot bed, maximum grade of 4 per cent and minimum radius of curvature of 191 feet. Most of the excavated material was solid granite. It was provided with a hard surface and after being used for the transportation of preliminary materials and machinery to the dam site, it was utilized as a portion of the road bed for the Hetch Hetchy railroad. Early in the operations, the city telephone line was extended along this road to the Hetch Hetchy dam site.

DIVERSION DAM AND TUNNEL.

In order to unwater the bed of the river at the dam site, a concrete diversion dam 40 feet high will be built by the contractor constructing the dam.

The water diverted from the river will be bypassed around the site of the permanent dam through a tunnel 23 x 25 feet, about 1,000 feet long, driven through very hard granite, most of which is suitable for concrete, and may be crushed and used in the construction of the diversion dam.

Operations on the tunnel were commenced with hand drills and carried on continuously with day and night crews until the headings met about three months after work was commenced. After the work was somewhat advanced, a $10,327 air compressing plant was installed which proved very satisfactory and also provided air for operating drills and machinery for other preliminary work, and for use during the construction of the permanent dam. The excavation of the tunnel so far completed has involved the removal of about 6,000 yards of rock at a total cost of about $6 per yard. The tunnel was excavated with a full width top heading and one bench. The design and execution of the work was carried on under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.

ORGANIZATION.

The headquarters of the city's construction operations in the Sierra Nevadas is in the town of Groveland, Tuolumne County. An engineering and clerical staff is located at this point to handle estimating, mapping surveys, keeping cost accounts, making up payrolls, paying the men employed by the city, ordering supplies, other clerical work, train dispatching on the Hetch Hetchy Railroad, and many other details which can be more efficiently handled in the field close to the construction work than in the city office.

A general storehouse and central warehouse has been erected at Groveland, from which all supplies used on the work will be issued. Regular stocks of all provisions and all building materials will be handled through the storehouse. Tools, many kinds of construction equipment, and replacement parts for construction machinery, are carried in stock. The use of this storeroom assures quick delivery at the various camps.

SAW LOGS AND FIREWOOD CUT IN HETCH-HETCHY VALLEY.

In connection with the storehouse an equipment shed has been erected for storage of all equipment not in use at the various works. Here, when necessary, the equipment is overhauled, repaired, painted and placed in working shape for the next job.

Soft Coal Storage

Prevention of spontaneous combustion and deterioration of bituminous coal stored in large piles may be effected to a large degree by observing the following precautions which are made in accordance with the conclusions drawn from official tests made by the United States Bureau of Mines:

Piles not to be over 12 feet deep, and no part of the interior to be over 10 feet from the surface.

Store only screened lump coal—if possible.

Keep out dust as much as possible, and to do this avoid handling.

Have lump and fine evenly distributed. Do not let lumps roll to the bottom and form air passages.

Rehandle the screenings after two months, if possible.

Store away from any sources of even moderate heat, and well away from the main buildings of the plant; never against a frame building.

Allow six weeks seasoning after mining before putting into storage piles.

Avoid alternate wetting and drying.

Avoid admission of air to the interior of the pile through interstices around timbers, irregular brick work or a porous bottom such as coarse cinders.

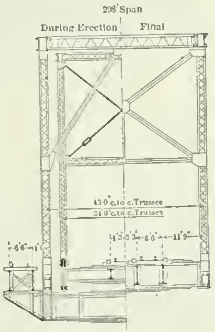
If wet coal is received, dump in small piles around the edges, where air can get to it freely to carry away moisture, and where other coal will not be packed on top of it.

Kenova Bridge Intermediate Spans

Erection of two 298-foot spans outside of old spans in service. Cantilever method using new end spans for anchorage. All steel raised 50 feet to track level by special car hoist. Two top chord travelers with two booms each, and capacity of two 51-ton loads at 70-foot radius. The floor beams, 67 feet long, were delivered on service track on cantilever span, lowered to barge, revolved 90 degrees, transverse to bridge axis and hoisted to position by traveler. Methods and plant used are suitable for consideration for replacement of long span municipal bridges.

In the re-building of the superstructure of the Norfolk & Western Railway Company's bridge over the Ohio River at Kenova, West Virginia, the two 298-foot single track end spans of the original superstructure were replaced by double track spans erected on falsework.

The three remaining spans were replaced by an entirely different method, being erected as cantilevers, clear of the old spans without involving the use of falsework, all of the operations being conducted, as for the end spans, practically without interruption of traffic on the old superstructure, the weight of which was eventually transferred to the new superstructure and finally removed, while the latter was supported from the original substructure modified as necessary.



Cross Section, Showing Clearance Between Old and New Spans.

The two intermediate 298-foot spans adjacent to the end spans of the same length are designated as spans 2 and 4 on the accompanying diagrams, and were cantilevered full length from the shore piers to the channel piers. All of the material was handled by steel mule travelers, one at each end of the bridge, advancing from the top chords of the end spans to the top chords of the intermediate span as the latter were successively erected. The steel delivered by rail in the low level storage yard at the south, or Kenova, end of the bridge was handled there by the 65-foot 30-ton booms of a tower traveler and of a stiffleg derrick that loaded it on low level cars that were transferred bodily by a vertical hoist to the high level material tracks installed or temporary cantilever brackets projecting from the ends of the floorbeams of the new spans.

The trusses of the 298-foot spans are 65½ feet deep 43 feet apart on centers with stiff bottom chords and riveted connections at panel points 29 feet 9⅝ inches apart.

ERECTION TRAVELERS.

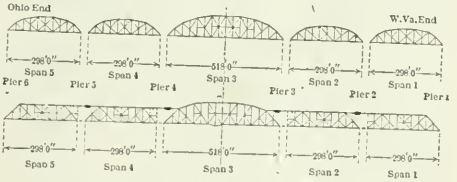
On the top chords of each of the new end span there was laid a traveler track consisting of two 8 x 16-inch timbers side by side with a rail spiked to each, on each of the trusses. On this track the small travelers commenced the erection of the two duplicate large travelers each with a 43 x 65-foot horizontal steel platform with 15-foot outriggers on each side at the forward end, and two 59-foot braced vertical steel masts with 75-foot booms of 65 tons capacity.

As the travelers were subsequently required to move on the inclined top chords of the center span of the bridge, the rear ends were afterwards supported by the adjustable struts shown in the diagram that were made with telescopic joints permitting the traveler platform to be maintained horizontal and insured the verticality of the derrick masts.

After the small traveler had erected the sills and floor of the large traveler, the former was shifted from its original track on the top chords of the old end span to one of the top chords of the new end span, and it erected on the floor of the new traveler a 12-ton steel derrick with a 65-foot boom which completed the erection of the large traveler and was then removed by the small traveler. The large traveler, weighing 423,000 pounds, was made heavier than was necessary for this work in order to be available for future work.

ERECTION TIES.

Spans 1 and 5 were each loaded at the shore end with 286,000 pounds of rails to act as cantilever counterweights and the old travelers were run as far as possible towards the shore end to assist in counter-balancing the weights of spans 2 and 4.



GENERAL ELEVATION OF OLD AND NEW SUPERSTRUCTURES ON OLD PIERS.

The adjustable horizontal erection ties in the lines of the top chords over piers 2 and 5 were about 125 feet long with gross cross-sections of 225 square inches to resist the direct tension of 4,000,000 pounds. They were plate girders made deep enough to resist the bending moment of the large traveler crossing on them from span to span. Their lengths were adjustable by overlapping slotted pin holes, each of them containing a round pin and a D-shape plug.

The erection ties were supported over the piers by temporary vertical members indicated in the diagram by dotted lines, most of which were so designed that they could be transferred to piers 3 and 4 for the erection of the center span.

MATERIAL HOIST.

All of the 9,600 tons of material in the five main spans of the bridge was loaded on flat cars at the storage yard and delivered to the hoist at the south end of the bridge. Here long members loaded on two or more cars were hoisted and placed on push cars made from freight car trucks, on the upper tracks, leaving the low level cars at the bottom of the hoist. When the material was delivered on single cars, however, the car itself was hoisted and run out on the upper level track to deliver its load to the erection traveler.

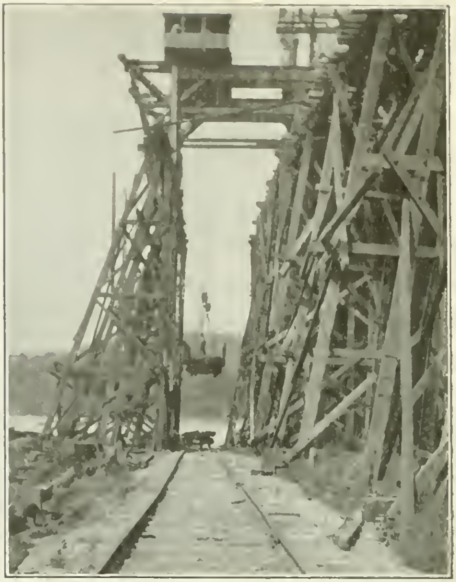
The material hoist had a wooden tower with transverse bents made with inner vertical posts and braced exterior batter posts resembling those of a gantry traveler. The posts supported two pairs of transverse plate girders spanning the upper and lower standard gage tracks parallel to each other.

On each pair of girders there was installed a four-wheel steel trolley equipped with a double drum electric hoisting engine operating a wire rope hoisting tackle and a Manila line tackle, traversing the trolley in one direction and hauling up a counterweight which pulled the trolley back.

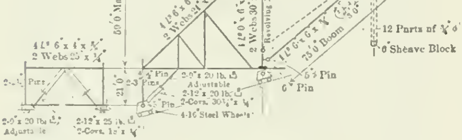
The cars had special connections to receive these trolley hoists and after they were transferred to the high level tracks they were hauled to the erection traveler by a dinky locomotive.

CANTILEVER ERECTION.

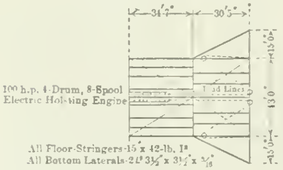
The end shoes were attached in the storage yard to the 54-ton end posts, adjustable eyebars were connected to that at the middle points, and they were each erected by one boom of the traveler. The lower ends and shoes were placed in the required positions and the end posts were temporarily secured by connecting the upper ends of the adjustable eyebars to the tops of the temporary erection posts on the piers that were also connected to the main adjustable erection tie.



SPECIAL HOIST FOR RAISING CARS AND STRUCTURAL STEEL TO SERVICE TRACK ON BRIDGE FLOOR.



210-TON OVERHEAD ERECTION TRAVELER WITH ADJUSTABLE SUPPORT AT REAR.


34'7"
30'5"
15'0"
130'
15'0"
100 h.p. 4-Drum, 8-Spool Electric Hoisting Engine
Load Lines
All Floor-Stringers-15" x 42-lb. I^s
All Bottom Laterals-2 L^s 3½" x 3½" x $\frac{5}{16}$"

FLOOR DIAGRAM AND ARRANGEMENT OF LEADS TO HOIST ON TRAVELER.

The remaining truss members in the two end panels were then assembled and the horizontal erection tie connected to the hip joint at the upper end of the end post, thus providing for the cantilever support of the truss and permitting the adjustable eyebars to be removed.

The traveler was moved out on the erection tie to a position over the center of pier 2 where it unloaded the first two floorbeams but had not sufficient reach to swing them to final position.

The floorbeams with their temporary extension brackets were 67 feet long over all, and in order to get them in position suspended transversely under the old span and clear of it, they were lowered by one traveler boom to a barge moored in the river below and then towed upstream until the other traveler boom tackle could be attached to one end of the floorbeam while the first boom was attached to the other end and together raised the floorbeam and held it until permanently secured to the bottom chords.

The stringers and material tracks were installed on the floorbeam brackets, the traveler advanced on the erection tie and top chords, the next panel of the trusses was erected and so on, until the trusses were completed with the river ends about 3 inches above their final positions.

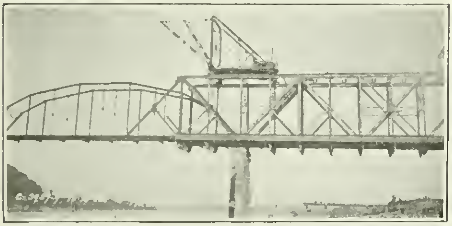
ADJUSTMENT OF SPANS.

Both old and new travelers were run over pier

FLOOR BEAM HOISTED TO FINAL POSITION AFTER BEING LOWERED TO BARGE.

2 so as to reduce their moments to a minimum. Jacking girders were attached to the adjacent ends of the spans, 1 and 2, and the jacks were operated under them until the tension in the erection ties was eliminated and each span was acting as a simple span. This required a raise of about 16 inches at the end of span 1, and 9 inches for span 2 which could not be raised farther without interfering with old span 2.

The D-shape plugs in the slotted holes of the splices in the erection ties were removed leaving the ends of the ties free to telescope over the round pin and still provide for the support of each girder in the traveler track. Traffic was stopped and the track broken for about 2 hours while the jacking was in process and the spans were lowered to final position on the piers.



OVERHEAD TRAVELER CROSSING OVER PIER ON TEMPORARY GIRDER-TIES.

After the adjustment of the new span, longitudinal I-beams were placed on their floorbeams and the weight of the old span was transferred to them, but the old trusses were allowed to remain as a counterweight while the new span served as anchor arms for the cantilever erection of the 518-foot center span, after which they were removed.

ADDITIONAL PLANT AND EQUIPMENT.

Besides the plant already mentioned there were installed on the job a 30-ton derrick car with 50-foot boom, and a 10-ton wooden derrick car. Each of the large travelers was equipped with a 100 h.p. four-drum, eight-spool hoisting engine operated by 550 volt D. C. obtained from a street car line. There were also eight steam hoisting engines on different parts of the work and two 65-h.p. two-drum, four-spool electric hoisting engines on the small travelers.

Field rivets were driven with pneumatic hammers operated by air compressed in a 12 x 12½ x 14-inch straight line compressor with a capacity of 285 cubic feet of free air per minute which was located at low level in the storage yards at the Kenova end of the bridge.

The track ties were framed by a movable machine having several adjustable circular saws for squaring the ends and cutting the dap. The saws were operated by a gasoline engine and the machine was moved from pile to pile of ties which were taken on at the front end and piled up at the rear as finished.

The bridge was designed, fabricated and erected by the American Bridge Company, C. W. Bryan, chief engineer, C. G. E. Larsson, assistant chief engineer, who devised the general construction method, W. G. Grove and Henry Taylor, assistant engineers. The diagrams illustrating this article are reprinted from a paper by W. C. Grove and Henry Taylor, published in the Transactions of the American Society of Civil Engineers, Volume 79, Page 411.

Stream Gauging Methods and Uses

An article with the above title was published in the March 6th issue of "Public Works," which was an abstract of a paper before the Connecticut Society of Engineers. It was the editor's intention to accompany this article with a foot note stating the source of the information, but the note was omitted by the printer and its absence was overlooked.

In calling our attention to this oversight, J. Frederick Jackson, director of the Bureau of Engineering of the Connecticut Department of Health, states that this "is an abstract of methods used and results obtained by this department in its investigation on the Naugatuck river in 1918 and 1919." The description itself, as printed in the annual report of the society, contains no statement or intimation of this, and our failure to state it was due to our ignorance of the fact.

Mr. Jackson also writes: "It was definitely understood that the account appearing in the 'Connecticut Society of Civil Engineers' was of a preliminary investigation, and that no conclusions other than general ones were to be drawn from it." Of this fact, also, we find no intimation in the paper as published by the society.

We are sorry that an oversight in this office caused the omission of credit to the society for this matter, and desire to correct this and to give publicity to Mr. Jackson's comments upon the paper which formed the basis of our article.

It has been announced that the Pennsylvania State Highway Department will in 1920 operate their own stone quarries and sand banks under the direction of a new department headed by D. M. Hepburn, Philadelphia.

Settling Foundations

Unstable pile footings in soft ground may be extended by deep piers or may be replacd by deep piers or by spread footings.

The Municipal elevator at Portland, Oregon, with a capacity of 45,000,000 lbs. of wheat has 63 concrete bins 14½ feet in diameter and 85 feet high that are supported on wooden piles from 45 to 60 feet long.

About 4,300 piles were driven in soft ground which they penerated an average distance of from 2 to 6 inches for each 10-foot blow of the 3,700-lb. drop hammer.

The displacement of the soft soil by driving the piles close together caused an upheaval of the surface which, after the driving had progressed for a certain time, amounted to about 1 foot. Longer piles were then driven, and after the concrete superstructure was built on them they settled so seriously that there was a maximum difference of 6 inches in level and an investigation was made to determine the cause and suitable remedy.

Test pipes and test piles were driven and test loads were applied and the results interpreted to indicate that the upper stratum of soil with a safe bearing capacity of about 2 tons per square foot was underlaid by a semi-fluid mass of smaller bearing capacity. The action of piles driven to a penetration of about 80 feet, indicated that shorter piles would not have a capacity for 25 tons each required, and that the soil to a depth of at least 41 feet below the surface was unable to bear the required uniform load of approximately 3.8 tons per square foot required for dead and live loads.

For one part of the structure where the settlement was not considered vital, it was recommended that additional piles should be driven around the footings to compress the adjacent soil and increase the area of the base and that if this proved beneficial the method could be extended to other portions of the construction.

Another plan was to underpin the existing structure by concrete piers carried down to bearing on a gravel stratum 170 feet below the surface.

The third method was for making entirely new foundations with spread footings calculated to impose an ultimate load of 2 tons per square foot on soil that is now sustaining 2 1/3 tons per square foot, without further settlement. The estimated cost of underpinning the operating house alone with deep cylinder piers varied from $140,700 to $350,000, while the cost of spread foundations for the same building moved to a new site was $150,000.

Except for the driving of additional wooden piles the reports do not suggest any consideration of the alternative or strengthening the present foundations or extending them by any other methods than the addition of exterior piles apparently intended chiefly for compressing and improving the bearing quality of the soil, nor for any method of temporary excess loading on present foundations calculated to rapidly develop total ultimate settlements and qualify them for reduced loading with an excess of bearing.

Handling Concrete Aggregate

Devices for saving labor in the handling of concrete aggregates are being tried out in a great variety of forms, and every month seems to bring information concerning some new variation of appliances or method for attaining this end. Two that have recently come to our notice have been used by contractors in Wyoming and Pennsylvania.

The Wyoming outfit is described as follows: Stationary bins were placed under a screening plant located at a gravel bed three-quarters of a mile from the job, from which bins sand and pebbles were mechanically loaded, through spouts, into three 3½-ton and one 5-ton White trucks. These were fitted up with three and six double compartments respectively, each carrying six cubic feet of sand and nine cubic feet of pebbles—the amount of each of these materials required for a 3-sack batch. The truck loaded with these three or five batches of aggregate ran direct to the mixer and dumped a batch at a time into the skip by releasing, in succession, the gates which separated the double compartments and which were hinged at the top. Cement was added to the batch in the skip by hand. It is estimated that this method of handling aggregates saved $80 per day over rehandling material between the screening plant and the mixer. This truck was used in laying concrete pavement in Thermopylis, Wyoming, by the Charles Connor Construction Company of Denver.

The other appliance, used in Pennsylvania state highway work near Lake Erie, consisted, of a horse-drawn wagon with two bodies, one above the other. Four bins of about twenty-five tons capacity each were erected at the railroad siding three-quarters of a mile from the nearest point on the road. A clam-shell unloader unloads aggregate from cars to storage piles and fills the bins from such piles. Each bin has a chute for loading wagons.

The wagon used is a standard dump wagon, into which is chuted the proper amount of stone and sand for one batch. A specially made box is then placed on top of the regular wagon body, and in this is deposited the aggregate for a second batch. The top box is attached to the bottom one by V-shaped angle irons, which in turn operate upon a shaft fastened to the rear end of the bottom box. This permits the top box to be dumped, revolving on this shaft. On reaching the mixer, the top box discharges its load directly into the skip, this being comparatively easy because of the fact that about one-third of the box overhangs the shaft about which it revolves. During or after the unloading of the top box, the contents of the bottom box are dumped upon a piece of sheet iron and reshoveled into the skip by hand for the next batch.

This limits the number of men employed on the skip end of the mixer to four. Twelve teams are used hauling material and there are eight men at the central plant, four to load wagons, one to operate the clam-shell, one fireman, and two to clean cars and assist around the plant. The Griff Construction Company, Erie, Pa., is the contractor.

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Reuse of Stone Paving Block

During the past few years a great many cities have found economy and other advantages in the practice of re-napping and re-dressing old stone blocks which had given several years' service, and relaying them on the same street, sometimes providing a new concrete base. One of the first cities to adopt this practice was New York.

The engineers of Manhattan estimate, however, that under certain conditions there are disadvantages which outweight the economy, or, to state it otherwise, the economical use of the blocks in this way produces outweighing disadvantages. Such an instance is that described in an article in this issue.

On the streets in question the traffic was so important and heavy that it seemed highly undesirable to interfere with it more than was necessary, and interference would undoubtedly result were the blocks to be re-napped and re-dressed on the street, which is the ordinary practice. Further, should the blocks be removed to a vacant lot or public yard, or other place where this re-shaping could be performed, and again returned to the street for laying, the cost of the double hauling would more than absorb the saving resulting from such re-use. Moreover, the delay thus occasioned would require keeping the street closed to traffic longer than would the use of new paving blocks which had previously been piled along the edge of the sidewalk. For this reason, the old blocks were not re-used, but were given to the contractor under the terms of his contract. As the contractor was able to sell these at $25 to $30 a thousand, and it is presumed that allowance for this was made in the bids submitted for the work, this failure to use the blocks in the new pavement did not by any means result in the total loss of their value to the city.

The above illustrates the fact that, in calculating the method which will make for maximum efficiency in paving work, there may be a number of items which do not appear at first sight. If we take into account the loss to the merchants and others by or for whom transportation of goods through the city streets is done, which would result from the temporary closing of important thoroughfares, it might easily appear not only that the re-dressing on the street of old stone blocks is, in the last analysis, far from economical, but even that there would be considerable economy in laying a pavement which would last twenty years without renewal, instead of a much less expensive one which would last but one-third of that time, and would call for the closing of the highway for repaving or repairs on three times as many occasions as would be necessary with the more expensive pavement.

Replacing Truss Bridges

The oldest steel truss bridges in this country are few of them more than 30 years old, but the rapid improvement in design, in materials, and in fabrication, together with the great increase of loading, plus the natural deterioration of structures and added injury from neglect and poor maintenance, has made virtually all of the older structures inadequate and few of these existing should not be immediately renewed. This has been more emphatically true of railroad structures which, as a general thing, have received more careful design and closer supervision, and a large number of which have already been replaced, some of them even being now about ready for a second replacement.

Highway bridges, often owned by the municipalities, and always by the public, have a large proportion of comparatively small structures which, although they should be handled in a scientific and expert manner, can be awkwardly handled without very disastrous financial results. As the spans increase, the question of replacement is a much more serious one, and as it is generally complicated by the necessity of maintaining traffic and the difficulty and expense of diverting the traffic away from the original alignment, and as the new superstructure is quite often built upon the old substructure, the perplexities and complications are likely to be great. When the experience or ingenuity of those in charge fail to find any other solution there always remains the possibility of diverting the traffic to a detour, or to a temporary new bridge established alongside, and the complete removal of the old structure and rebuilding of the new one as two separate complete operations.

This may sometimes be necessary, but is always very expensive and can often be avoided. Virtually the same problem has been met and solved by specialists in railroad and bridge engineering and the methods employed are in general applicable to highway structures. An illustration of this is given on page 237 in the description of the reconstruction of several long spans of an old bridge on which train service was maintained uninterrupted while the substructure was modified and the new spans, self-supporting during erection, were built outside the old spans, and traffic transferred to them before the old spans were replaced and this without obstructing the channel between the piers by falsework. This interesting practical demonstration indicates what may even more readily be applied to many highway structures that will soon need replacement without disturbing the traffic or obstructing the clearance under the bridge.

Improving an Inadequate Foundation

The description on page 240 of the foundation problem for a large elevator seems to indicate incompetent design, careless construction or supervision, and a narrow view of the present problem as to what should be considered as the safest and most economical correction of the original error. The original application of 25-ton loads to piles 45 to 60 feet long driven 2½ feet apart and penetrating 6 inches with the last blow of the hammer is preposterous. The recommended imposition of a unit load of 2 tons on deep plastic material that settles considerably to a final apparent stability under 2 1/3 tons is very hazardous to say the least, while the underpinning of a single one of the group of buildings at a cost of $350,000 for very deep concrete piers only partially solves the problem and is extremely expensive.

In the absence of plans and complete information, farther criticism or specific suggestions are not very valuable but it seems to the outsider that it would be very desirable to give careful consideration to some alternative methods of relief that may be found available. In New York City and elsewhere when heavy buildings are underpinned with new footings the load is frequently transferred to comparatively small sections of them in such a way as to overload them considerably beyond their final duty and immediately secure enough compression and settlement to develop permanent bearing capacity in excess of the requirements and thus insure stability under the decreased final load. Enclosing the site with a subterranean wall to prevent lateral displacement of the plastic soil or some system of artificial solidifying the soil might be helpful. The construction of a few deep piers and the accurate proportioning of the load between them and the existing foundation might also be found to be economical. Various schemes of this sort may be proposed by experienced contractors that have accomplished remarkable results in underpinning heavy structures by ingenious and daring methods that amply demonstrate their qualifications to design and execute work such as involved in this case, and which would have been unnecessary if they had been employed on the original construction.

Construction Accidents

It is authoritatively stated that in 1917 3,000,000 accidents occurred among industrial workers in the United States resulting in the disablement of 300,000 men and the death of many. While many of these accidents doubtless occurred in shops, mills, and manufactories, a large proportion were in engineering construction and, no doubt, a great majority of these were preventible.

The importance of these accidents which rival the casualties in battle, and besides human suffering involve a cost of many millions of dollars, is so well recognized that burdensome legislation has been enacted to provide compulsory insurance for employes and many "safety first" and engineering safety organizations have been formed.

In the able paper on cooperating on safety published in this issue, accidents are classified according to their number; those occurring during the handling of materials, from protruding nails, from stumbling, and from falling material being far the most numerous. Nearly one-third of the total number in the specific cases chronicled were bruised fingers, and about half as many were where the feet were punctured by protruding nails. This classification involved only ordinary kinds of heavy construction, such as steel erection, concreting, buildings, grading and track work, and did not apparently include the especially dangerous classes of work such, for instance, as tunnelling, quarrying, pneumatic caisson work, or the erection of lofty steel spans, in which conditions are sometimes so precarious that serious accidents are apparently inevitable. In these cases, however, the danger is so well recognized that extreme precautions are taken, rules are rigidly enforced and, especially of late years, the toll of casualties has been greatly decreased so that it perhaps is not larger on the whole than in some less dangerous callings where greater carelessness prevails.

Accidents are most efficiently prevented first, by the employment of more intelligent labor; second, by a continuous campaign of warning and education; third, by the conspicuous posting and rigid enforcement of safety rules and finally by the establishment, in large organizations of a safety department headed by a competent engineer or superintendent with authority, and the provision of ample facilities for the immediate relief of injured men.

The planning in advance and the co-ordination of all important portions of the work with close attention to details of methods and the selection, installation and operation of plant, goes far to reduce accidents at the same time that it lessens the cost of the work, expedites it, and indirectly more than pays for itself in the reduced cost of insurance against accidents which, under these conditions, have been reduced in two or three years to a fraction of their former proportions by some of the leading construction firms in this country.

Labor Shortage and Its Relief

Every one in this country admits the deficiency, low quality and unreliability of skilled and unskilled labor, but few perhaps realize just how great the shortage is. Recent authoritative statements estimate that there is a shortage of 33 per cent of common labor required in the United States and that the additions from immigration, now only about one-third as large as before the war, will, for a long time, be very much less than the losses from the departure of aliens. Today it is believed that there are about 4,000,000 workers short on account of decreasing immigration. Until recently the foreign-born workmen provided more than half of the unskilled labor in the basic industries.

It is very evident that immigration to this country should be encouraged, not discouraged, and that the aliens should be properly distributed according to their capacity and the demand for their services. A sort of labor clearing house should be established under joint public and private management. Its greatest danger would be from political interference and socialism that should be primarily guarded against by every possible precaution.

State Highway Construction in New York

By JAS. H. STURDEVANT*

The third of three articles. In this are described the approved methods of building a concrete highway; placing the concrete, leveling, screeding and belting; making expansion joints and curing the surface, providing water supply, building bridges, culverts and retaining walls. The standard construction equipment is enumerated and the character of engineering supervision and inspection is defined.

Concrete is deposited on subgrade between side forms, usually steel channels laid on it and held in position by pins driven through lugs projecting from their flanges. The surface is leveled with shovels and rakes and the top is dressed to the required transverse crown by means of a concave wooden screen or template usually lined with steel, that is moved forward with a reciprocating zigzag motion making a stroke of 1 or 2 feet. forward and back alternately at each end. It is handled by one man at each end and is moved on the upper flanges of the side forms that give it the required elevation.

Screeding is followed by the belt finish, applied by two men pulling a canvas belt back and forth transversely across the surface of the concrete, after which it is generally rolled lightly in a transverse direction by a hand roller about 6 feet long weighing 15 to 20 pounds per linear foot that is operated from one side of the road by a long handle or sometimes operated from both sides of the road by hand lines.

EXPANSION JOINTS.

Expansion joints located from 30 to 50 feet apart, according to specifications, are usually made with some manufactured, compressible filler extending through the full transverse width of the road and from top to bottom of the concrete. This joint or filler is generally attached to a steel plate or board put in position before the concrete is placed and withdrawn afterwards leaving a space which is immediately filled by the fresh plastic concrete. The edge of the concrete on both sides of the filler must be smoothed which is generally done by a workman with a split float. In order to avoid injuring the finished surface of the fresh concrete, a light plank bridge spanning the roadway and supported on the forms or on the right of way beyond them at the sides should be provided so that when the surface requires additional finishing between joints it can be done by the use of the bridge, moved along on the side forms.

CURING THE CONCRETE.

Each day's run of concrete should be kept saturated with water for 6 to 14 days and in hot weather should be protected from the sun for a like period to insure its proper and rapid hardening. When practicable it is generally most satisfactorily accomplished by the ponding method, which consists of building clay dams 4 or 5 inches high on both longitudinal edges of the concrete and cross dams of the same height at convenient intervals, and then filling the spaces enclosed between the dams with water from 2 to 4 inches in depth. This is easily accomplished on level grades but where there is a slope, the cross dams have to be closer and closer together as the slope increases and when they are nearer than 10 feet the method becomes expensive and troublesome. For grades above 2 or 3 per cent, the curing is usually effected by covering the surface of the concrete with sand or loam and keeping the latter saturated during the day time.

WATER SUPPLY.

Water for curing should be piped along the road and if pipes are not already installed along the road and a supply is not available from an existing municipal water system, the contractor will have to establish a supply at some stream or pond or from a well, pump it to some elevated reservoir and distribute through main and branch pipes from 1½ to ½ inch in diameter, thus providing a supply which will also suffice for a steam engine, and for concrete mixing.

If the earth cover system of curing is used, water should be supplied through long lengths of small size pipes connected to the main supply by flexible hose, and perforated with ⅛-inch holes about 12 inches apart through the full length of the pipe. Pressure should be constantly maintained on these pipes and they should be moved from place to place as the ground is saturated in one place and drys out in another.

STRUCTURES.

The principal structures ordinarily required on highways are bridges, culverts and retaining walls. In New York State bridges of more than 5 feet span are provided by the town or county and they should be completed as soon as possible after the bed is graded and before the road itself is surfaced.

Retaining walls are generally built on side hill slopes and may be either of rubble masonry, usually laid in cement mortar, or of concrete built in forms. In any event their foundations should be carried down to horizontal surfaces, solid rock or reliable hard stratum and they should have gravity sections with ample width to resist all possibility of displacement or overturning unless they are of concrete of the cantilever or buttress types, which are very special and cannot be treated in a general article.

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In all cases they should be well provided with weep holes and bottom drainage to prevent the accumulation of water and the formation of ice behind them. They must of course be built wholly in advance of the draining and road surfacing. When built of concrete the latter may be mixed at a higher elevation and spouted to place or at low elevation and delivered by derricks. Under favorable conditions large, massive concrete may be put in position at a cost, with present prices of labor and materials, of $8 to $12 per yard.

Culverts for small streams are usually made of concrete or cast iron pipe from 10 to 30 inches in diameter, which should be installed before the embankment is made and should be laid with carefully made cement joints. The ends of the culverts should be embedded in concrete thoroughly protecting them and forming a face at the foot of the slope. In many cases it will be necessary to extend this with face walls or wings to protect the slope.

Usually large culverts up to 10 or 12 feet in width are made with concrete invert and side walls and concrete archways built with ordinary collapsible interior forms and any convenient type of exterior forms where needed. Above a width of 10 or 12 feet culverts are usually replaced by bridges with a wood or concrete floor.

EQUIPMENT.

For a 5-mile section of standard concrete highway through rough country involving perhaps from 1,000 to 10,000 yards of cut and fill per mile, an average efficient equipment for constructing a new road through country would include a 20 to 40 h.p. steam boiler or air compressor, with capacity of 500 cubic feet of free air per minute, six to twelve jackhammer drills, blasting machine, one dynamite magazine, one 1-yard steam shovel, one 20 h.p. tractor or tractor plow, one 10-ton steam roller, one concrete paving machine, two gasoline locomotives, 4 miles industrial track, 20 flat cars, 40 batch boxes for cement and aggregate, one unloading derrick or one bucket elevator, one 100-yard stone bin, one cement storage shed of 1,000-barrel capacity, two 5-ton automobile trucks, 25 wheelbarrows, 50 shovels, 25 picks, 20 tarpaulins, 6,000 feet of water pipe with valves, one movable office building together with axes, saws, hammers and other ordinary small tools and supplies. The steam shovel, tractor and some other portions of the equipment which probably answer for two 5-mile sections as well as for one. Some of the items would have to be increased or eliminated according to the presence of more rock work and timber or its absence.

SUPERVISION.

The engineer's force should maintain constantly on the work, an inspector or engineer to every 5 miles, more or less according to conditions. He should give and check, all lines and levels, provide notes for preliminary grades, inspect the subgrade and slopes and finished surface. He should insist on proper preliminary drainage, prevent the obstruction of streets and arrange well in advance for by-passes and detours to maintain traffic. He should carefully inspect the materials, testing if necessary, and should closely watch the operations and quantities used and should be responsible for the accurate proportioning of cement, sand and broken stone and water, in the concrete mixer.

He should be a man of experience, ability and reliability to whom discretionary powers are awarded, permitting him in minor matters to decide on relaxation or added stringency of the specifications for the benefit of the work, and to enable both contractor and owner to take advantage of special conditions arising. Important matters, he should of course refer to the chief engineer.

A willingness to make slight modification in the specification when it will serve the contractor's convenience or expedite the work without injury to it, will generally be appreciated by the contractor and promote a spirit of willingness to reciprocate by exceeding the specifications when necessary and securing hearty and loyal co-operation for good work.

The contractor's superintendent and foremen should be thoroughly impressed with the idea of doing the best possible work, in the most rapid and efficient way and to detect and voluntarily rectify all mistakes, thus assisting and being assisted by the engineer's representative. For every large or difficult work, the contractor should have a responsible engineer frequently on the ground to check quantities and to foresee, avert, and correct difficulties, and if there is much equipment he should provide a master mechanic and a trained force to maintain and repair the plant.

American Pavements in Japan

There are in Japan so few hard surface roads and pavements, that almost the entire highway system of the Empire awaits modern construction and amovement has been started to secure it. Prof. T. Takakuwa (219 W. 106th street, New York City) of the Kiriu Technical College is now visiting New York to study conditions and standards for the design and construction of American pavements in Japan, notably in the cities of Tokio and Osaka which have respectively about 600 miles and 300 miles of dirt streets of which not more than two or three miles, in Tokio have pavements.

A paving campaign is to be started this spring to secure within the next ten years the construction of about 200 miles of first-class pavement in Tokio. At present the traffic, although considerable, is light, consisting chiefly of horse-drawn vehicles with trucks up to 1-ton capacity and some pleasure automobiles. It is intended to provide for an increasing commercial traffic up to perhaps two or three tons. Special attention is given to bitulistic pavements, although there is in Japan abundance of stone for concrete and macadam.

It will be necessary to import all of the road making machinery, and probably some contracts will be awarded to American contractors.

Laying Sewers in Quicksand

Trench sheeted and subdrained then floored with reinforced concrete and pumped while pipe was laid and jointed.

Over a large part of the city of Jacksonville, Fla., water is found a few feet below the surface of the sand which constitutes the soil, as a result of which most of the sewers are laid in quicksand, or at least a sand which will flow wherever the water will. The sewers are laid from 5 to 11 feet deep, and at four points along the water front the house sewage (the separate system is used) is lifted so as to flow into the St. Johns river.

A small job of sewer construction which the writer saw under way in March was said to be typical of most of that done. A 10-inch sewer was being laid about 10 feet deep, ground water being encountered at about 6 feet. The trench was close-sheeted with 2-inch planks, and the joints between the planks kept calked with oakum. (In some cases tongue-and-groove planks were used.) The sheeting was driven with mauls and carried 2 to 3 feet below the sewer grade, to prevent the sand rising into the trench. In spite of these precautions quite a little sand entered the trench and caused caving of the banks.

The sand was excavated by hand. To facilitate handling the water, cross-sheeting was driven at intervals of about 50 feet and each section completed before pipe laying was begun in the next. Ordinarily work was going on in three sections at once—excavating to water in the first, bottoming out and laying sewer in the second, and back-filling and pulling sheeting in the third. A 4-inch or 5-inch subdrain was laid below the sewer to enable the trench to be kept dry during sewer laying. The water was removed by a diaphragm pump operated by a gasoline engine.

The trench was carried a foot deeper than the outside bottom of the sewer, the drain tile laid in the bottom, and 7 inches of cinders placed around it for a width of 18 inches. On these was placed 1:2:4 concrete to a depth of 5 inches, reinforced with ½-inch square rods on 18-inch centers, or with "expanded metal, wire mesh, or other approved reinforcement of equal value." On this was laid the vitrified sewer pipe, and the concrete carried up to a height of 4 inches above the bottom of the pipe, with a total width of 18 inches out-to-out, boards being set longitudinally as forms for the sides.

It is believed that this construction gives a permanence tightness to the sewer, in spite of the running sand in which it is laid. Piles are used under the sewer through swampy ground.

When a sewer is left for the night or at the completion of a section, a draining plug is fastened into the bell of the sewer with oakum. This consists of a round plug of 1-inch boards which fits loosely into the bell. In the center of the plug is a hole through which passes a 4-foot length of old suction hose from a diaphragm pump. About 2 inches of this hose extended through the plug, the end was slit in six or eight places and turned back onto the face of the plug and nailed there. This hose extended beyond the sewer and was fastened with its end just above the sand but below the water, thus draining the ground water from the trench ahead without letting in the sand.

The city has contracted with the Massey Concrete Products Corporation for reinforced concrete pipe for the larger sizes of sewers and some has been received, but none laid as yet (March 13). The so-called "tongue-and-groove" or beveled joint is being used rather than the bell and spigot.

Displacement of Earth in Sewer Trench

There are under construction in Detroit, a 32 x 17¾-foot twin box sewer and a 24-foot, 8-inch by 15 foot, 9-inch, five-center arch sewer built-in trenches 75 feet and 50 feet wide at the top and 22 feet deep that are excavated through vegetable mould and stiff yellow clay to a depth of about 13 feet and thence to subgrade through very soft plastic blue clay.

The larger trench was excavated by transverse cuts of a 3½-yard bucket operated by a 135-ton dragline machine that at first deposited the spoil close to the bank of the trench.

After about 130 feet of the trench had been excavated but not sheeted about 60 feet of the side adjacent to the spoil bank slipped into the excavation and the bottom raised 8 feet. The trench was re-excavated and the excavation continued until about 500 feet of the trench had been opened and half of the bottom covered with the concrete invert. A second slide then occurred in which the center of the spoil bank, 25 feet high that loaded the ground to about 1 ton per square foot, subsided forming a 60x250-foot crater and causing an upheaval in the bottom of the trench that raised it 3 or 4 inches under the first end where the invert was laid, and 10 or 12 feet at the opposite end. The edges of the bank were not much displaced.

The 50x22-foot trench for the arch sewer was excavated to a depth of 10 feet by a steam shovel and the remainder of the spoil was taken out by a dragline excavator that also handled the backfill. The slide which occurred in this trench was a side slip and an upheaval of the bottom.

In all cases the damage was repaired and construction resumed, care being taken to keep excavation, concreting and backfilling completed as far as possible and leave little unfinished open trench.

The obvious conclusions are, that under these conditions, the bank should not be overloaded by spoil and that where there is sufficient cover and suitable cross-section tunnel these methods are likely to be more advantageous than open cuts in this material.

Competent engineer is wanted to take charge of the construction during the next six months of an electric lighting plant for the city of Apalachicola, Fla. Address J. F. Warren, city cashier.

A 10,000,000-Feet Gas Holder

Cylindrical Tank 273 feet in diameter contains 8,500,000 pounds of steel. Bottom-plate riveted upon blocking on concrete base and lowered to sand cushion.

The new steel tank for the Peoples Gas Light and Coke Co., Chicago at 35th street and Crawford Avenue, has a capacity of 10,000,000 cubic feet, equal to 16,000,000 gallons of water and is 273 feet, 3 inches in diameter and 38 feet, 4 inches high, containing 8,500,000 pounds of steel that has been fabricated and erected by the Bartlett, Hayward Co., Baltimore.

The full size circular concrete foundation slab 12 inches thick in the center and 24 inches thick on the edges was built in a pit 8-feet deep from which 20,000 yards of earth was excavated by two steam shovels.

LOWERING BOTTOM.

The surface of the concrete base was covered with 2 inches of dry sand and temporary wooden blockings were placed on it to receive the steel base plates which were assembled together 27 inches clear of the top of the concrete. After they were field riveted their support was transferred from the wooden blocking to 42 screw jacks placed around the circumference and 192 screw jacks set on the concrete and projecting up through holes left for the purpose in the steel plates. These jacks were simultaneously operated and lowered the steel bottom to position with the rivet heads embedded in the sand that formed a distributing cushion, in 1 hour, 15 minutes. The jacks were then removed, the holes sealed, and the assembling and riveting of the circular steel wall commenced.

ERECTION OF WALL.

On the center of the bottom there was installed a temporary steel erection tower 50 feet high, guyed at the top where there was a long, hollow steel gudgeon projecting above the top of the tower to serve as the axis of two revolving radial cranes. These were two independent horizontal box girders with their outer ends resting on steel towers that traveled on a circular track laid on the tank bottom. Derrick booms were installed on the tops of the towers, one of them to handle the steel wall plates and the other to handle the large pneumatic riveter with which about 1,000,000 field rivets up to 1⅝-inches diameter were driven.

The sides of the tank were built in 8 courses of plates about 5-feet wide and from 2-inches to ½-inch thick with horizontal lapped joints and vertical butt joints having inside and outside cover plates. Compressed air to operate the hoisting engine and develop the 150-ton pressure in the riveting machine was delivered through the hollow gudgeon in the center tower. All of the riveted joints are calked with pneumatic tools. The top of the tank was made of light steel plates assembled and riveted in position on a permanent wooden framework that rests on the bottom of the tank.

Mitta Mitta Dam

The largest irrigation dam to cost $8,000,000 and impound 272,000,000,000 gal. Has curved earth embankment 2,700 feet long and 85 feet high.

The governments of New South Wales, South Australia, Victoria and the Commonwealth Government have commenced construction on a dam across the Murray River at Mitta Mitta, 6 miles from Albury which will cost about $8,000,000 and store 43,560,000,000 cubic feet or 272,250,000,000 gallons of water in a reservoir covering 30,300 acres of land and providing for a flow of 90,000 cubic feet of water per second.

This dam which is said to be the largest in the world, will have a total height of 94 feet above the bed of the river, 85 feet above the surface of the ground, and about 120 feet above the granite stratum on which the foundations are built. The dam will have a curved alignment 3,601, feet long including a concrete spillway 710 feet long, concrete outlet 161 feet long and earth section 2,700 feet long.

The spillway located in the original river bed will be of cyclopean concrete with a gravity cross-section and will be surmounted by 30 bridge piers carrying the elevated highway and serving as abutments for 31 vertically moving shutters 20 feet wide with a rise of 15 feet. They will move in sliding guides and will be operated by turbines installed in wells at both ends of the spillway.

The earth section of the dam will be 32 feet wide, 85 feet high above the surface of the ground with slopes of 3 to 1 and 2 to 1 on the upstream side and 2½ to 1 on the downstream side. The concrete core wall will be caried into bed rock and the granite hill sides. During construction the flow of the river will be by-passed through two 20x20-foot concrete tunnels built through the spillway and eventually closed by reinforced concrete bulkheads.

Philadelphia has about 600 miles of streets aggregating nearly 10,000,000 yards of asphalt pavement for which the average annual repair appropriation for the last 10 years has been $325,000 which has been found inadequate. John C. Winston, director of the Department of Public Works, has therefore applied to the city council for appropriation of $175,000 for the installation of an asphalt mixing plant with a capacity of 2,500 square yards in 8 hours. It is estimated that the plant can be equipped in about six months, could be worked continuously during the whole year and thus enable defects to be immediately repaired and promote the convenience and welfare of the public, even although the unit cost of the work done might be no less than that under the contract system.

Co-operating on Safety*

F. J. C. Dresser,‡ *the Austin Company, Cleveland.*

* * * The present day of multiple-story buildings, when radical changes in their construction methods are being employed, finds us facing the source of the greatest number of accidents, as is attested by the high insurance rates. Usually the public comes in for consideration, as far as safety methods are concerned, and in fact no other class of structure requires more consistent planning or forethought as regards accident prevention, unless it be in tunnel or subway work as installed in our larger cities. For this work it is plain that proper and substantial equipment must be provided, that possesses a good, safe factor; the sidewalks and streets must be covered; riding loads and in hoists must be forbidden; stairways and ladders must be liberally provided; mechanical safeguards installed; rapidly moving load lines and signal cords boxed or otherwise protected; safety belts and scaffolds provided; and even a man's clothing must receive attention, for many a man has lost a hand by reason of his wearing a gauntlet glove, and others have lost arms and life because of a loose sleeve or glove which dangled into revolving drums, or shafting, or which were caught by a broken strand in a cable.

DANGEROUS WORK.

Heavy foundation work requires the same care in accident prevention study, both in bridge and in building work.

Pile driving is another hazardous piece of work, where moving timbers and lines are responsible for many avoidable accidents.

Wrecking and underpining are other sources of accidents, and more numerous undoubtedly than should be because they do not receive the attention of an engineer as regards a plan, or in other words, the average wrecking contractor does not have a staff or an engineer in his service to make calculations before doing work. As a result, defective material is often used and insufficient underpinning installed, causing accidents, of course.

Heavy rock excavation requires care in handling dynamite, and precaution against flying rock and destruction of property.

Industrial building work is the source of possibly the greatest variety of accidents, but usually not as disastrous to life and limb as the previously mentioned classes of work.

An analytical study in the direction of safety, no matter what the class of work, will certainly produce results if undertaken with the same spirit that a construction engineer plans his layout and schedule.

EMPLOYES.

In a large measure the application of safety methods depends on the employe. The more intelligent, the less liable is he to accident. In this respect, the ironworker or steel erector is possibly the most versatile in that he thinks of the possibilities of things happening in connection with the work in hand, and is not so easily caught unaware. * * *

No other mechanic requires good judgment more than the hoisting engineer, especially be he engaged on multiple-story building work or heavy bridge construction. The common laborer, however, requires more watching than the trade mechanics, and in this respect much depends on the intelligence of of the foreman who directs his movements. * * *

CHARACTER OF ACCIDENTS.

Our records, from a recent piece of construction, which involved steel erection, heavy concrete, brick work, and grading, also track work, show, from a total of 242 accidents, that: 73 employes sustained bruised fingers from handling material, 37 employes sustained punctured feet from nails, 11 employes sustained cuts on head from falling material, 7 employes sustained sprained ankles, slipping and misstepping, 7 employes sustained cuts on hands, and the balance were minor injuries. This work comprised the erection of a large engine terminal, and this record conforms in the average to the class of accidents which we must safeguard against in the course of our regular industrial building construction.

I find in comparison with figures as derived by other concerns, that the accidents in the main are similar in character, but the percentages vary, due undoubtedly to the character of the work in hand.

The greatest number of accidents, we find, come during the handling of material, and are confined to hand injuries; second in number come injuries to feet from protruding nails; third, employes falling, by reason of misstepping or stumbling over strewn material, causing sprained or broken ankles, broken arms or legs; fourth, falling material, causing cuts about the body and broken limbs. These are the four main causes as we find them, and it is natural, therefore, that preventive measures be provided in the order named.

I believe it goes without question that a job properly planned, and scheduled whereby one phase of the work closely follows the other, where material is received and handled in the same order and where orderliness prevails throughout, is rewarded by the least number of accidents.

Receiving and storing of material is a study in itself, for naturally the best position must be selected for hoists, and also for storage. One should be near the other to avoid rehandling and increased costs ,and minimum handling also reduces the possibility of accidents. * * *

The main object is to eliminate distance, for work is really distance versus resistance, as the definition goes, and the further application of all possible mechanical means to handle material from cars or wagon to position is another factor which results in a great reduction of accidents.

NAIL ACCIDENTS

Our second consideration being given to nails, we find that orderliness in handling of lumber containing protruding nails, eliminates foot punctures by the score. Plank or forms of this character should be stacked with nails down and not be allowed to be strewn all over the job. In order to reuse the plank or board, the carpenter must drive the nails back, and their removal as soon as the plank or brace is taken down is undoubtedly the best practice. As regards concrete form lumber that has been stripped, if it has no further use in the building as fabricated, it should be stacked and nails removed by the cleaning gang, if there is one, as soon as possible to make it available for other use, for certainly the reuse of lumber these days is economy, and a carpenter usually will take a new piece rather than stop to remove nails. In a multiple-story concrete building, forms are usually stripped and immediately placed in position for the next floor, and the same applies to braces, so that the immediate removal or driving back of nails is necessary and foot punctures are made less possible than on the ordinary timber or house job. Elimination of strewn lumber will reduce nail accidents and its reclamation should be taken in hand at once in order to make it fit for re-use, which in itself will cause a saving in the final lumber bill.

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*Excerpt of paper delivered before the Construction Section of the Eighth Annual Safety Congress of the National Safety Council at Cleveland.

‡Representing Associated General Contractors of America.

FALLING ACCIDENTS.

To avoid employes falling, railings should be erected on staging and scaffolds; runways of sufficient width provided; and material generally should not be strewn promiscuously about the job. Openings should be covered or railed and good stable ladders built. Climbing up or down hoist towers should be forbidden, and all moving lines boxed so as to avoid tripping. Working aisles should be kept clear of waste and surplus material.

To avoid falling material, storage of the same should be confined to the interior aisles, and scaffolds provided with a sideboard to prevent brick especially from going over the edge.

In discharging debris, closed-in chutes should be installed, wheeling runways to be of sufficient width and overloading of wheelbarrows forbidden, especially when brick are being moved. * * *

RULES AND INSTRUCTIONS.

The construction department should turn over to the safety man a complete schedule of the job in hand, showing the progress expected, this being the first step. Second, a set of safety rules should be issued applying to the work or particular job in hand, which are set up after the due analysis of the conditions which are to be met. The third, is of course, the enforcement and application of these safety rules.

First of all, any job employing 125 men or more, dependent, of course on character of the work and location, should have a first aid attendant and small field hospital. We find it pays decidedly by eliminating lost time.

Second, the job organization should appreciate thoroughly the meaning of this safety work and they will in the end discover that lower unit costs will result from the observance of the safety rules.

The workmen should be taught to observe safety rules provided as a precaution against the first or possibility second classifications, which are most liable to happen. * * *

Descriptive photographs are an immense help in avoiding accidents and educational work, and should be in keeping with the class of work in hand.

Periodical bulletins help greatly, as do also signs which should be of such size and meaning as can be understood by all. A sign that can be read only a few feet distant is not of much use; it should be readable at a considerable distance—the farther the better.

Another idea is to have progressive signs, or those which move forward with the work, cautioning what in particular may result from the work in hand at that time. These signs should be right on the job and not posted on the office door, which may be a mile away from the job. * * *

In addition, safety meetings should be held on the job by the foremen and a plan of action or procedure decided upon before particular pieces of work are undertaken, also work covered should be reviewed. * * *

Around the plant generally, guards should be built which will eliminate the possibility of employes coming in contact with the moving parts and lines, and the same consideration must be given to hoists and hoist lines. * * *

Safety rules further will establish under what conditions a machine is to be operated and how, and will also establish signal codes to be observed, for very often the operator cannot see the other end of the line or the top of the hoist, as the case may be.

* * *

Above all else you must have experienced machine operators, and none other should be permitted to be employed.

The whole work, however, as regards both employes and equipment is to be reviewed and inspected by the safety engineer. * * *

Generally speaking, this subject is one that is becoming more important each year, and the increasing obligation to co-operate with safety is plain, considering the fact that in 1917, in our United States, 300,000 men were disabled and 3,000,000 minor accidents occurred in our industrial army. * * *

Waterproofing a Reservoir for 10½ Cents Per Square Foot

In the Lindsay-Strathmore Irrigation District, California, a 2-acre reservoir that was excavated in a gravel deposit proved to be so leaky that it was lined with about 114,000 square feet of reinforced gunite 1-inch thick requiring 2,900 sacks of cement and 600 tons of sand.

The gunite was placed with a N2 gun operated by air at 32 lb. pressure at the nozzle, delivered through a 2-inch pipe of maximum length of 200 feet. The nozzle was connected with the gun by 200 feet of 2-inch rubber hose and the cement was deposited on poultry netting at a maximum rate of 5,000 square feet per day. The work was done by nine men receiving $4.00, $5.00 and $7.00 a day wages that aggregated $41.00 per day. Between 8 and 9 per cent of the cement rebounded and was collected, screened, and used over again. The gunite was carefully sprinkled for two days until properly cured. The contract price was 10½ cents per foot.

Safety Rules for Construction Work

Information for the management, issued by the National Safety Council, 208 South La Salle street, Chicago, for superintendents and foremen.

FIRST CONVINCE YOURSELF that accident prevention is worth while. It reduces accidents 75 per cent or more, it reduces labor turnover, and increases efficiency. Others have obtained these results; resolve that you will obtain them.

GET THE MEN TO THINK AND ACT SAFETY. Instruct all new men in safety when they are hired. Appoint safety committees and safety men. Install safety signs, warning signs, and safety bulletin-boards. Invite the men to suggest safety rules and cautions.

USE SAFE METHODS IN DOING THE WORK. See that all safeguards are used, that materials are safely moved and well piled. Do not overload equipment, floors, falsework or scaffolds. Keep passageways open and the entire job clear of rubbish. Do not let bolts, nuts or small tools lie around to be knocked off or tripped over, nor boards with projecting nails to be stepped on. Permit no one to stand or work under a load or to ride a load being hoisted, and do not hoist a heavy load with a horizontal boom. Prohibit horseplay and practical jokes and see that they are eliminated. The public should be excluded from the job.

USE GOOD TOOLS AND EQUIPMENT. Inspect frequently and keep them in good condition. Guard all gears, pulleys, belts, electrical apparatus, etc. Provide goggles when needed to prevent eye injuries. Remember that the goose neck and gudgeon pin are the critical points of a derrick. Discard all poor equipment at once. The strength of guys, hoisting lines, ropes, blocks, hooks, chains and slings and their fastenings should be beyond question. Keep tools sharp and handles and striking faces in good condition.

USE GOOD TIMBER, WELL FRAMED AND SWAY BRACED for false work, scaffolds, shores and temporary supports. Prevent falls and injuries from falling objects by providing hand rails, toe boards and wire screens around elevated structures, scaffolds, openings and pits. Keep ladders and runways in good condition.

DO NOT WORK IF CONDITIONS ARE UNFAVORABLE because of high wind, poor light, storm, heat or cold, etc.

FIT THE MAN TO HIS JOB. Do not let a reckless, drunken or sick man work for you.

BE VIGILANT. Instruct your men to be watchful for the safety of themselves and fellow-workmen.

BE PREPARED FOR ACCIDENTS. Secure a first aid kit and learn why and how to use it. When starting a job find out about doctors, hospitals and ambulances and post the information near the telephone. Learn the prone pressure method of resuscitation from drowning, asphyxiation and electric shock. Treat all small cuts and scratches to prevent infection.

Steam Shovel Excavating Sewer Trench from Subgrade

The Ryan Co., Chicago, has recently excavated a long section of deep narrow sewer trench on Elstone avenue and Augusta street, where the clearance was very narrow transversely and shallow overhead, by means of a self-propelled steam shovel provided with a small dipper having a handle 18 feet long and operated at subgrade of the trench.

The steam shovel dug itself down to the bottom of the trench about 11 feet deep, 14 feet wide at the bottom and 17 feet wide at the top. As it advanced, the bucket dumped directly into 4-yard automobile trucks backed up in the street on the center line of the trench just in advance of the machine which excavated 280 yard per 8 hour day.

As fast as the excavation was made, the trench was sheeted with vertical planks, braced by three tiers of transverse struts behind the shovel, and one strut in front in the lower tier so that the maximum distance between braces was never more than 12 feet and then only when the shovel was in operation.

Where the trench passed under a railroad bridge with only 18 inches clearance over the top of the bucket, the excavation was made in longitudinal halves, each alternately extended 6 feet beyond the other on which the automobile trucks were spotted. They were necessarily placed in such a position that the bucket could only empty on the rear end of the trucks so that it was necessary for the bucket to be operated by the crowding engine to shove the dumped material forward in the truck to make place for another bucketful, and so on until the truck was loaded. After the steam shovel had passed under the railroad bridge, it was elevated to the surface by cribbing and jacking and was removed and replaced by a 70-ton shovel operated on the surface of the ground.

Cement Joints for Iron Pipes

About 4,000 linear feet of 6-inch and 6,000 feet of 8-inch cast iron pipes for the salt water fire protection system at San Pedro, Cal., were laid with cement joints of which only three proved defective when subjected to 48 hours for a test pressure of 180 pounds per square inch for 2 hours.

Special care was taken to set the pipes solidly in the bottom of the trench, wedging them on wooden blocks if necessary before jointing them. Soft yarn entirely free from grease was soaked in liquid cement and just enough was placed in each hub to prevent the cement from entering the pipe.

Riverside Portland cement, as dry as would permit it to be formed, was inserted in the joint and tamped solid with a large hand calking iron until the cement could not be compressed more and the tool made a ringing sound, when the joint was wiped with cement paste leveled to a 45° slope. The trench was back filled between joints which were covered with wet sacks for 48 hours before the pressure test was applied.

Preventing Dye Waste Pollution of Streams

Investigation by United States Public Health Service included aeration, charcoal preparations, chlorine, lime, boiling, alkali, strong reducing and oxidizing agents. These were compared with evaporation as a standard of cost, and ferrous salt, slaked lime and filtration recommended.

In many cases the most difficult problem to the engineer in connection with the treatment of sewage to prevent the pollution of a stream, is furnished by the trade wastes which reach the sewers or the stream direct. Each class of wastes presents its own problem, and frequently the problems for a given class vary with the individual plants.

Liquid wastes from the manufacture of dyes are particularly objectionable because of their properties of high color, bad taste and strong odor, even in very low concentrations. The treatment of such wastes was studied by the United States Public Health Service at the plant of the Chemical Company of America, located at Springfield, N. J., between Two Forks of the Rahway River. The results of this investigation was embodied in a report made in January, 1920.

In connection with the report, there is given a suggestion for a systematic set of steps to be followed in investigating and experimenting on the treatment of wastes. Evaporation is considered the simplest form of treatment for liquid effluents. On the basis that one pound of coal will evaporate 6½ pounds of water and that coal costs $7 a net ton, evaporation would cost 0.44c per gallon.

COMPARISON OF METHODS.

Any method which is to be preferred to evaporation must ordinarily be applicable at a cost less than this. The figures given below are the maximum quantities of the various materials that can be used in order that the process be cheaper than evaporation; the figures being based on market prices in June, 1919:

(1) Try aeration for blowing out bad odors.
(2) Try Filchar up to 8 pounds per thousand of waste for removing odor and color.
(3) Try chlorine (in both acid and alkaline solution) up to 8 pounds per thousand for improving odor and color.
(4) Try copperas and lime for precipitating color; also alum and lime, etc.
(5) Try boiling for removing bad odors.
(6) Try partial evaporation for removing bad odors.
(7) Try strong reducing agents; also strong oxidizing agents.
(8) Try strong alkali up to 5 pounds per thousand of waste.
(9) Investigate the manufacturing process with reference to making use of the waste again several times. For instance, in the case of the residue from the manufacture of toluidine by acid reduction of nitrotoluene, this waste might be fortified with strong acid and used again.
(10) Try shaking out with ether up to 5 pounds per thousand of waste.
(11) Try dilution.
(12) Try bacterial action.

If no satisfactory improvement is obtained by any one or combination of these schemes, then the special chemical and physical properties of the objectionable constituents should be studied.

For instance, an aldehyde might be oxidized to an acid having an insoluble lime salt, or a nitro compound might be reduced to form an amine removable by filtchar. An aromatic primary amine might be precipitated as an azo compound.

Other absorption compounds than filtchar, such as kelcar, norite, coke, talc, fuller's earth, should be studied if they offer cheaper possibilities.

With special reference to dyes which are salted out, there is a good field for studying the recovery of salt from the wastes by evaporation.

It should be remembered in any case that the waste must be made alkaline after treatment, if it is not already so, and should be allowed to stand in air as a test, for it will be oxidized as well as made alkaline in the river.

The removal of the dyes by electrical precipitation may be a field for study. It could not be studied at the experimental plant for lack of direct current power.

The above steps were followed in the investigation herein referred to, which dealt especially with toluidine, nitrobenzene, monoethyl aniline, and dye wastes, also with liquor in a lagoon into which these liquid wastes had been discharged previously. Treatments cheaper than evaporation were found that were successful on a 300-gallon scale for the lagoon liquor and for the several wastes except toluidine, and a method of treating the last was indicated by laboratory experiments.

TREATING TOLUIDINE.

Among the treatments tried for toluidine was boiling alkaline filtered waste liquor with boneblack, which was found to remove both odor and color; but the same result was accomplished by filtering the same liquid through a layer of boneblack ¼ inch thick. Quantitative experiments showed that about 1.1 cubic feet could be passed through 1 pound of boneblack before it became exhausted. Tests were made of several grades of a new carbon which has appeared on the market under the trade name of "filtchar," which appeared to be superior to ordinary carbon. "If it be assumed that a practically odorless liquid is wanted with a color of not more than five parts per million on the arbitrary scale selected, it is seen that this can be obtained by the use of 0.3% superfiltchar, or 0.8% filtchar with a treatment of 18 hours or so."

Coke and cinders failed to remove any odor or color on a large scale or in the laboratory. The above refers to toluidine waste only. When lagoon liquor was used, charcoal failed to remove the color, but boneblack, filtchar and kelcar were found effective.

RELATIVE COSTS OF METHODS.

As an illustration of relative costs, those for toludine waste were given as follows:

	per 1,000 gal.
Chlorination, 30 grams of chlorine to the liter	$15.00
Evaporation	5.00
Boneblack, 0.9 pound to the cubic foot	10.80
Filtchar, 8 pounds per 1,000 gallons	4.00
Superfiltchar, 3 pounds per 1,000 gallons	3.50

The advantages of the filtchar treatment over evaporation are that the former requires less equipment and is more flexible as regards the quality of the treated waste. These figures are based on the cost of filtchar of $.06 per pound and superfiltchar, $.14.

The cost of the several methods of treating lagoon liquor per thousand gallons were given as follows:

Evaporation	$5.50
Chlorination, 3 grams to the liter	1.00
Superfiltchar (pharmaceutical), 0.85 gram to the liter	1.33
Superfiltchar (oil grade), 0.95 gram to the liter	1.08
Filtchar, 1.7 gram to the liter	.83
Filtchar, 2.5* grams to the liter	1.25
Kelcar, 1.1 grams to the liter	.41
Precipitation, using 9.6 pounds of lime per 1,000 pounds of waste, and $FeSO_4$, 1.2 pounds per 1,000 pounds of waste	.74

TREATMENT RECOMMENDED.

On the basis of the investigation it was recommended that the Chemical Company mix together all the wastes and wash waters, except those from the "direct green" series of dyes, add ferrous salt in a wooden vat; slaked lime to neutralize the acid and give in addition eight pounds per pound of iron; to be followed by filtration through a sand filter bed or other suitable filtering medium and dilution of the effluent with at least five times its volume of water.

Street Lighting from Municipal Refuse

In a recent editorial, "Municipal Journal and The Sanitary Record," of London, used a news item which appeared in "Municipal Journal" as the text for an editorial. The editor said:

An illustration of enterprise, such as is common with American municipalities, is that furnished by the city of Scranton, Pennsylvania, who recently, according to our American contemporary "Municipal Journal," retained Mr. Frank Koester, consulting engineer and city planning expert, New York City, "to make an investigation and report regarding an entire new system for lighting all streets and some forty municipal buildings. Mr Koester proposed to use the garbage and refuse (60 tons per day) as the bulk of the fuel required. The present maximum daily demand of the power plant is 500 kilowatts; however the plant is provided for twice this capacity. Some 1,300 nitrogen-filled tungsten lamps are to replace the present arc lamps. In addition, a very extended boulevard-lighting system of some 400 single-lamp standards are provided for the four business sections of the city. With the exception of the underground wires in the business sections, all other wires of the eleven circuits are to be overhead. The engineer's report shows that the city will save yearly some $25,000 by owning this municipal lighting system instead of renewing the contract with the local light company. A similar report was made very recently by the same engineer for the city of Allentown, Pa., where the savings effected would be $15,000 per year. We should much like to hear more of the scheme proposed by Mr. Koester. It is not a novel one to municipal and electrical engineers in this country. For twenty years ago great hopes were entertained that English cities could be lighted by electricity generated from the house refuse consumed in refuse destructors—hopes, however, which have failed to fructify, for we know of no English city which has made a success of it."

Nor do we know of a single city in this country which has made a success of this idea, although it has been recommended for many and tried at great expense by several. The English cannot credit (or charge) us with any originality in this matter, however, since most of the proposals to adopt this plan in the United States have been based upon the reported success of the scheme in England.

With failure to make a success of the plan in either country, further propositions for adopting it should be required to demonstrate the development of more favorable methods and conditions if they are to receive serious consideration.

Pile Driving with Submerged Hammer

The foundations for two piers of the Bear River Bridge on the Yarmouth, Nova Scotia division of the Dominion Atlantic Railway, consist of wooden piles driven to a maximum penetration of 46 feet in pits excavated to a depth of 35 feet below low water and 70 feet below high water.

The piles were driven inside a flooded cofferdam by means of a vertical guide frame suspended, from cofferdam cross timbers. The guide frame was a hollow rectangular framework like a strut, made with four 3½ x 3½-inch corner flange angles latticed together on all sides and having an interior clearance of 22 x 22 in. over the countersunk river heads. Horizontal flange angles on the upper end of the frame supported it from the cross timbers and the foundation piles were dropped through the guide frame, sometimes penetrating the bottom to a depth of 10 feet by their own weight.

The 5,000-pound drop hammer with the sides bevelled at the lower end, was inserted in the top of the guide frame and allowed to fall on the pile top from a heighth of 12 to 15 feet which was as much as the piles would endure without injury. The maximum penetration was 46 feet.

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* By using 2.5 grams instead of 1.7 grams, the color was reduced from 12 to 8.

Pier 18, Jersey City

Substructure of coal handling and storage plant. 6,000 long piles driven with weighted steam hammer and hydraulic jet. 5,000 yards concrete mixed and placed by floating plant. Concrete forms anchored against uplift of fluid pressure. Pre-cast girders concreted on pier and handled by special quick-acting yoke. Design, methods and erection plant suitable for municipal construction.

The construction and equipment of Pier 18, Jersey City, will provide for the Central Railroad of New Jersey a very complete and up-to-date plant for receiving, classifying and reshipping 400 cars of coal per day and for the maintenance of a large stock of different sizes and varities of coal available for immediate delivery by gravity to tugs, steam ships and barges alongside the pier.

The plant is built with inclined tracks on which the cars, after passing through a large hot air thawing building, are delivered to two dumping machines, and after being unloaded are returned by gravity to the classification yards, while the coal is loaded directly into barges or is conveyed to the end of a long pier and deposited in any of the numerous storage bins to be provided with chutes for delivering to boats moored alongside.

GENERAL DESCRIPTION.

The pier is 184 feet wide at the shore end, 66 feet wide at the river end and 1,600 feet long. The approach to the pier on the shore was built up about 25 feet above high water level by the hydraulic fill process with materials dredged from the slip alongside which at the same time was deepened to 30 feet as described March 13, page 187.

The pier itself has a creosoted wooden pile foundation supporting the heavy reinforced concrete slab deck on which concrete piers have been built to carry reinforced concrete track girders, that extend to the beginning of the storage bins, which have not yet been installed. In general, the pier construction was of three types: (a) Track area, pile bents 15 feet on centers, piles in double bents 4 foot centers capped with 10 x 12-inch creosoted Y. P., and with a 10 x 12-inch filler between the rows at low water and another 5 inches below the top of the caps, thus forming a key for the concrete slab which is 20 inches thick and very heavily reinforced; (b) Dumper foundation pile bents 3 foot centers, piles spaced 3 feet apart capped with 10 x 12-inch and floored with 5 x 10-inch planks about 12 inches above low water, from that elevation a concrete foundation holding the anchor bolts for the dumping machinery is carried up to the general level of the pier; (c) Deck area outside of dumper foundations and track area. Single rows of piles 15 feet on centers, piles spaced 4 to 5 feet in the bents, capped with 10 x 12-inch and a 12-inch reinforced concrete deck on top of the caps in which were driven ¾ x 12-inch spikes to give rigidity. The work already executed consists principally of the dredging and filling, the erection of the thawing house and dumping machinery, pile driving and the concreting of the deck and piers.

PILE DRIVING.

About 450 of the piles for the foundations of the thawing house were driven through the filled materials and the remainder, about 5,000 in all, were driven in the pier substructure through water varying from 20 to 30 feet in depth and penetrating mud, sand, gravel and indurated material almost as refactory as hardpan. The work was done with one floating machine and two land machines.

The piles, most of them 60 to 75 feet long, were of Southern yellow pine, creosoted at the railroad company's plant at Port Reading and delivered thence to the site in lots of 100 each by catamarans floated alongside the pier. The piles were hewed to blunt points without shoes, except in the case of the thawing house piles that were provided with cast points bolted on with straps.

SPOTTING PILES.

The piles in the pier were driven with a floating pile driver equipped with a heavy drop hammer. They were lined up by ranges on two sets of vertical battens nailed to horizontal planks set by the engineers, the sets being about 60 or 70 feet apart and being moved ahead as the work progressed. These battens were uniformly set to correspond with the upstream edge of the pile, namely at a standard distance of 6 inches beyond the center point, and were sighted on by the "monkey" continually stationed in the head of the pile driver's tower to spot the piles and direct the operator.

The longitudinal spacing of the piles was determined by a float stage made of heavy timbers spiked together; this stage was moored to the last transverse bent completed and provided at the outer edge with bearings against which the next bent was driven. Many of the bents were double bents and where a single bent was driven and the length of the panel increased correspondingly, the width of the stage was enlarged to match by boltnig to it a timber of the required thickness.

JETTING AND HAMMERING.

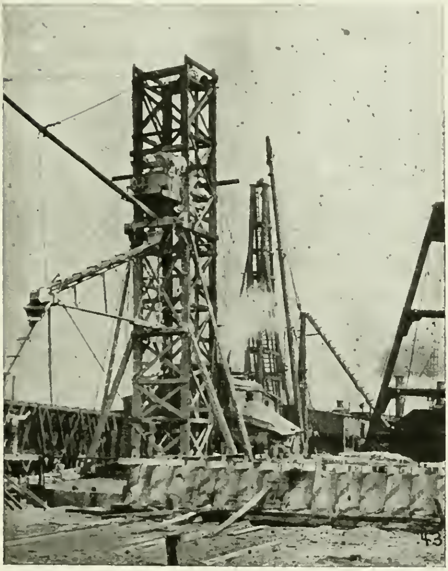
As many as 80 piles per day were driven by the floating machine but no such average was maintained, due to the complicated nature of the foundations and the difficulty in securing a sufficient quantity during the war. The thawing house foundation piles were driven with land pile drivers on rollers. Before driving, a hole was made in the fill by a ¾-inch hydraulic jet at 150 pounds pressure delivered through a 2-inch pipe. The hydraulic jet pipe was then placed alongside the pile and this was operated while the pile was driven by the steam hammer. One of the steam hammers was a 5,000-pound National hammer with a 2,000-

pound drop hammer lashed to it to increase the weight. The other was a 10,000-pound Vulcan hammer with a 5,000-pound striking hammer.

The pile driver crew, consisting of an engine man, captain and eight helpers, ordinarily drove about one pile per hour. The drivers were immediately followed by the stay-lathing gang of eight men, who lined up the piles and braced them, and in turn were followed by the framing gang of eighteen to twenty men, who sawed off the tops of the piles by using hand crosscut saws operated on pairs of horizontal guides nailed to the tops of the piles. This gang also capped the piles ready for the concreting gang. The stay laths were secured at the ends with lag screws provided with eyes in which bars could be inserted to turn them more easily than was possible with a wrench. At intersections and intermediate points the stay laths were secured with spikes.

CONCRETING.

Rectangular U-shape hangers were made of 1 x ⅛-inch flat steel with the ends twisted 90 degrees and pierced with two holes through which they were secured to the tops of the 10 x 12-inch pile caps with 60-penny nails. The hangers were bent so as to be somewhat offset from the sides of the caps and to receive the 4 x 12-inch temporary stringers, set in their loops and adjusted by wedges to be ⅞ inch below the tops of the caps. On these stringers there were placed floor panels of ⅞-inch tongue-and-groove boards fastened together with cleats, providing a uniform surface flush with the pile caps over the entire pier to support the floor slab concrete from 12 to 20 inches thick. Longitudinal and transverse reinforcement bars wired together at intersections were assembled on the floor and supported at the proper heighth on steel wire chairs.



SPOUTING CONCRETE FROM FLOATING PLANT TO MAKE MASSIVE FLOOR SLAB, PIERS AND PRE-CAST GIRDERS.

Concrete was mixed in the contractor's floating plant installed on a scow 36 feet wide and 229 feet long. On it there was a cement storage shed from which cement bags were delivered to the concrete mixer by a belt conveyor. There was also an elevated aggregate storage bin and a boom derrick with clamshell bucket that unloaded pre-mixed sand and gravel of the proper proportions from supply barges moored alongside. From the storage bin aggregate was delivered by gravity to the charging hopper installed above the 1-yard Ransome mixer. The mixed concrete was discharged directly from the mixer to the bucket in the bottom of the hoisting tower 71feet high.

At the top of the tower the concrete was discharged into a receiving hopper and thence was spouted to the forms through steel chutes, the first section of which was supported on the inclined top chord of a trussed boom revolving about 250 degrees around the hoisting tower. From the extremity of this boom a second, swiveled section of the chute, guyed to the top of the tower, provided a flexible distribution of the concrete through a radius of nearly 60 feet.

The concrete piers supporting the viaduct tracks were from 4 to 5 feet thick, 10 to 20 feet long and about 23 feet in maximum heighth above the top of the deck. The sides were slightly battered and the form for each was made with a single panel of transverse boards nailed to cross pieces, those on the two long sides slightly overlapping the end pieces that fitted between them. They were connected by horizontal bolts passing through tin tubes which permitted their removal after the concrete had set. Eventually the tubes were filled with mortar. In order to resist the uplifting tendency of the wet concrete that would otherwise raise the forms above the top of the deck, the latter were anchored down by small wire ropes attached to the upper part and secured to eyebolts temporarily screwed into permanent nuts provided ni the concrete floor slab. The forms were handled by floating derricks. The floor concrete was made in batches of about 150 to 200 cubic yards per shift, arranged so that each one could be completed the day it was commenced.

PRE-CAST GIRDERS.

With the exception of the approaches to the dumper, the tracks on the pier are carried on about 200 reinforced concrete girders 15 feet long, 5 feet in maximum depth and 18 inches thick, that weigh about 6 tons each. These girders have parallel top and bottom surfaces 3 feet apart, except at the ends where they are cast integral with knee-braces and have the maximum depth of 5 feet as already mentioned.

A portion of the deck was reserved for a casting floor large enough for 24 girders that were concreted in a single tier in a horizontal position with the wide sides down. The forms were made with single panels for each side, the panels consisting of vertical ⅞-inch tongue-and-groove boards nailed to 4 x 6-inch top and bottom wailing pieces that overlapped and were bolted together at the corners

The girders were cast in lots of 12 ,each girder having three vertical dowels cast in the upper edge and projecting a few inches beyond it to secure the track ties. A 4 x 4-inch reinforcing timber was temporarily bolted to these dowels to strengthen the girder for handling. After 24 hours the forms were stripped, cleaned, painted with form oil, and set up again for casting another set of girders and so on.

LIFTING YOKES.

After the girders were one week old, they were handled to storage or to position by means of a special yoke attached to them at the center of gravity. This yoke consisted of a 6 x 8-inch transverse timber with a vertical 1½-inch screw rod through each end engaging a bottom plate. The lower ends of the screw rods were provided with welded loops fitting a 3 x 1-inch bottom plate about 2 feet long that slipped through them and took bearing against the horizontal lower surface of the girder, when the nuts on the upper ends of the screw rods were adjusted, thus holding the yoke firmly in position by friction. An eyebolt at the center of the transverse timber provided connection for the hoisting tackle. This yoke was found very convenient and could be very rapidly handled since it was only necessary to loosen the top nuts and slip out the bottom bearing plate to detach it and to reverse the operation for securing it to the next girder. The girders were erected by a locomotive crane.

The work was designed and executed under the direction of the engineering department of the Jersey Central R. R., A. E. Owen, chief engineer; A. M. Zabriskie, principal assistant engineer; H. E. Van Ness, construction engineer, and L. M. Hannaford, resident manager. Henry Steers, Inc., was the contractor; B. M. Wheeler, engineer, and David Bonner, Jr., superintendent.

Labor Relations in Cleveland

The committee on labor relations of the Cleveland Chamber of Commerce have just made a report containing a declaration of principles that has been printed and issued and the contemplation of the formation of a community labor policy for Cleveland to which extensive neswpaper publicity has been given since March 1, has elicited considerable comment on the principal points of representative negotiations, open or closed shops, information, and the settlement of labor disputes.

INCREASED PRODUCTION.

The report urges increasing production as a prime factor of reducing commodity prices and that this requirement should regulate profits, wages, hours and working conditions. Employees should not, therefore, intentionally restrict individual output to create an artificial scarcity of labor, but they should recognize the duty of the employer to adopt new improved machinery and methods to increase efficiency and reduce the cost of production. Employers on the other hand should not intentionally restrict production to create an artificial scarcity of the product in order to increase prices and should not reduce piece rate prices simply because they have become highly profitable to the employee through the latter's increased skill. Employers should also adjust their production program so as to afford a maximum continuity of employment consistent with efficient business methods.

WAGES.

In fixing the scale of wages, consideration should be given to the cost of living, opportunity to advance standard of living, saving, loyalty, quality and quantity of productivity, initiative and individual skill, nature and hazard of the work, importance of the work performed, punctuality and steadiness and continuity of employment.

HOURS

Hours of work should be fixed at a point consistant with the physical well-being of the worker, providing for leisure, recreation, home life and self-development, overtime work should be discouraged, one day's rest in seven should be provided and the Saturday half holiday should be encouraged.

Every effort should be made to perfect the conditions of employment with special reference to heat, light, ventilation, safeguarding the health of workers and providing protection against industrial accidents and occupational diseases, adequate notice should be given to those who must be necessarily laid off and employees should give reasonable notice of intention to leave the service.

COLLECTIVE BARGAINING.

There should be established that form of collective bargaining which provides for negotiation between an employer and duly accredited representative of his employees, regarding hours, wages and all other matter properly affecting their relationship. The right of an individual employe to negotiate directly with his employer, should not be abrogated and employers and employes should uphold in their integrity or arbitration award or agreements entered into between them.

OPEN SHOP.

Freedom of contract of employment must never be impaired. Employment should not be arbitrarily conditioned on membership or non-membership in a trade or labor union.

Employers should inform their employes on the subject of business principles as affecting their mutual interests, especially the relation of wages and expense to cost and prices and the necessity for an equitable return on invested capital and, employes should be frank in discussing with their employer, matters affecting their conditions of employment and the interest of their industry.

Violence, intimidation, ostracism, humiliation or blacklisting cannot be tolerated in labor relations on the part either of the employer or of the employe.

The employe's right to strike and the employer's right to lockout his employes are both secondary to the public right to service. In essential industry, government services, and public utilities, prompt settlement of dispute should be effected by the efforts of both parties. The public's right to uninterrupted service during the period of settlement is a primary consideration.

According to the Massachusetts Highway Commission, the present cost of third-class bituminous road 18-feet wide is about $35,000 per mile, as compared with $15,000 to $16,000 in 1914 and 1915.

Derrick Boom 100 Feet Long

The terminal for the city of Tuscaloosa, Ala., is situated at River View, where there is 1½ miles of river frontage a short distance from the city and extensive improvements have been made including facilities for land and water shipment and storage and for future industries in the vicinity.

A group of buildings, of which one has already been built, 100 feet long, are to be served from a centrally located derrick already installed. This steel derrick, made by the American Hoist & Derrick Co., has a mast 115 feet high, a 100-foot boom and a stiffleg 145 feet long. It is designed for a capacity load of 15 tons and has been tested up to 25 tons. It is equipped with a clamshell bucket for handling coal or gravel and is mounted on a concrete pier 20 feet high and 20 feet square at the base with a footing of piles driven to a penetration of 20 feet.

With this derrick considerable timber has been loaded on cars in units of 1,000 feet board measure, which are handled rapidly at a charge of 75c each.

The work of the derrick is expedited and increased by a system of steel containers in which small quantities of freight are packed so that a number can be handled at one operation of the derrick. The container is a steel box with hinged sides that are lowered while the box is filled and then are closed and locked and the box weighing 5 tons, lifted by rings attached to the hoisting tackle so that 5-ton units of freight can be handled every 3 minutes by the derrick.

Similar steel containers are satisfactorily used in New Orleans for shipping by river and rail to remote points. In this case the containers are made larger, one of them occupying half the floor of a flat car.

Rapid Irrigation Construction

The $400,000 Williams Irrigation District system is designed to irrigate 10,000 acres of rice California lands.

The system will take water from the Sacramento river and convey it in a main canal ten miles long so constructed that its capacity can be increased.

The main canal is one-third completed and lateral construction is under way. The total yardage of 400,000 has been 25 per cent moved. Thirty miles of laterals will be built.

Pumping facilities will consist of a large plant at the river with two booster plants on the project. The river plant will have a capacity of 300 cubic feet per second supplied by four 36-inch pumps, each directly connected to a 300 h.p. induction motor. The minimum lift is 22 feet. The Latourrette-Fical Company, Sacramento, is installing the pumps. The three pumping stations will cost $220,000.

Ponding Concrete Roads

Extensive use has been made of the ponding method for curing the 18-foot concrete Salt Lake-Ogden Highway, 32 miles long in Utah. At first the surface of the fresh concrete was covered with two or three inches of wet earth which was found troublesome, expensive and not entirely efficient, and has been abandoned there except for grades of more than 6 per cent. On level surface or light grade the construction slabs 30 to 40 feet long are enclosed by small earth dams impounding from 2 to 3 inches of water. On grades from 3 to 6 per cent the dams are placed closer together. The water used for the ponding method is probably less than that required for the wet earth method.

Driving Inclined Concrete Sheet Piles

About 1,700 linear feet of inclined sea wall at Long Beach, Cal., was constructed early this year by driving 42-inch concrete sheet piles about 17½ feet long. They have an approximately channel-shape cross section with 5-inch web and 12-inch flanges. In each unit one flange is provided with a dovetail projection forming the male portion of an interlocked installation joint and the other flange has a corresponding recess forming the female portion of the joint. Most of the piles have a vertical penetration of about 10 feet, of which the last 18 inches is in a clay stratum.

The piles were driven by a wooden tower traveler equipped with leads inclined at an angle of 53 degrees, with the horizontal in which was installed a steam hammer supplementing the action of four 3-inch hydraulic jets which delivered a pressure of 60 lb. per square inch, through one-inch nozzles.

The work, including the demolition of an existing wall by blasting and battering, backfilling with a clam-shell bucket and with a 6-inch centrifugal pump, was accomplished in about five months at the expense of $112,000. The Ross Construction Co., of Sacramento, Cal., was the contractor.

Knock-Down Floor Forms

Slab and beam floors have been concreted in knock-down forms that are easily handled and facilitate stripping. Ordinary falsework timbers transverse to the beams are first erected and on them the soffit pieces of the beams are laid and the vertical side pieces of the beam forms are put in position, nailed to the soffit pieces, and braced by bottom spacers wedged in position.

The soffit pieces for the floor slab are then set on the side pieces of the beam forms with notched engagement holding them in place and leaving open the corner where the beam and floor intersect. This space is covered by a narrow curved strip of sheet iron tacked to both slab and beam pieces and thus forming an elastic fillet completing the trough system of forms.

When the concrete has set it is easy to knock out the spacers, pull the double-headed nails, collapse the forms and strip them from the concrete in separate pieces more easily handled than massive rigid box forms.

Concrete Roller Patent Suit

A patent for the use of a roller in finishing the surfaces of concrete pavements and certain features of construction of such a roller is held by the Macon Concrete Roller Co., and on March 11 it brought suit for infringement against the Brooks-Callaway Company, of Atlanta, claiming that this company has sold many rollers that infringe its patents.

Vehicles for Refuse Collection

For several months a discussion of the use of motor vehicles for refuse collection has been carried on by English engineers in the columns of "Municipal Engineering and The Sanitary Record," from which discussion we have quoted several contributions. A recent contribution, which has appeared in that periodical, was by J. A. Priestly, superintendent of the Cleansing and Baths Department of Sheffield. His conclusions, after "considerable experience in the use of motor vehicles for refuse collection," are as follows:

The question of the most suitable means of transportation to be employed depends upon a number of factors, the most important of which are the facilities for loading and the number of stops—the radius of mileage is a far less important matter. If a load can be quickly picked up at one point and delivered at a point a few miles distant without intermediate stops, petrol vehicles may show the best results; but even under these circumstances probably a steam wagon would do the work more cheaply. If the load has to be picked up from point to point, with stops of some duration, petrol vehicles cannot compete with electric under these circumstances.

In my opinion it is impossible to lay down any standard which can be generally applied in determining this matter, as the conditions governing it cannot be standardized. Speaking generally, the following principles may be considered to have been amply demonstrated:

(1) Horse transport is cheapest only on very short leads.

(2) Electric vehicles are cheapest for town collection and delivery where frequent stops are essential and the total mileage is not very considerable.

(3) Steam wagons are most economical for heavy loads from point to point where the distance is reasonable.

(4) Petrol vehicles are most suitable for long distance haulage.

A Simple Tool Holder

A convenient and efficient handle to hold a chisel point or cold cutter is illustrated in a recent publication by the National Safety Council, Chicago. It has a rod ⅜ inch in diameter and 2 feet long with a circular eye at one end and a screw thread at the other end. The rod is inserted in a ¾-inch pipe sleeve 10 inches long with an outside screw thread at one end which engages a clevis with V-shape notches in both wings.

A wing nut is screwed on the threaded end of the rod bearing on the end of the cleeve, and is set to allow the notch to register with the inner end of the eye. The circular shank of the drill point or cutter is then inserted in the eye and in contact with the notch, and the wing nut is adjusted to pull the eye towards the notch, thus holding the point or cutter firmly in position. The device is very simple, can be made by any mechanic, and will be found efficient and convenient. The interposition of a leather or rubber bushing in the socket eliminates most of the vibration caused by hammer impact.

How to Lose $1,000

The contractor for a 3-span reinforced concrete bridge in Pennsylvania was confronted with the problem of building a pier in a river bed where there was one or two feet of water with a small current and the bottom was a boulder stratum 6 or 8 feet deep underlaid by 3 feet of clay over horizontal bed rock. The boulders were not cemented by silt or other accumulations and were of moderate size, few of them exceeding one-man stones. The contractor's men wading in the water, removed as many as possible and then attempted to cofferdam the pier site by driving 2-inch square edge wooden sheeting through the remaining 4 or 5 feet of boulders above the soft bottom.

A cofferdam about 8 x 30 feet under a maximum head of 10 or 12 feet was required and the contractor built a light trestle falsework enclosing it and giving access to the shore for a working platform on which men with heavy mauls started to drive the sheeting. After long continued efforts this was found to be impossible and the contractor abandoned the attempt after spending at least $1,000 to no avail.

Had the contractor realized the impossibility of penetrating the boulder stratum and at first cleared the site as might easily have been done by a clamshell or orange peel bucket operated by the derrick already installed to handle the masonry, the cost would have been comparatively light and the work would have been greatly expedited. As it is, this method has now been adopted and the work should be carried to a successful conclusion without further difficulty.

The unsuccessful cofferdam had two lines of sheeting about 2 feet apart that with much difficulty were assembled and driven to a slight penetration. The space between the rows of sheeting was filled with a good quality of puddle and a large centrifugal pump was installed which handled a large quantity of water, but was unable to free the cofferdam because the river came up abundantly all over the bottom between the stones, making it evident that the whole structure will have to be abandoned, the cofferdam removed and the stone cleared from the bottom by clamshell or orangepeel buckets that will enable piles to be driven to bed rock and a suitable cofferdam constructed that will have a sufficient seal on the surface of the rock to permit the interior to be pumped out without great difficulty.

For an adjacent pier where the boulders were smaller and the stratum was somewhat thinner the contractor succeeded in driving a single line sheet pile cofferdam deep enough so that it cut off a large amount of the flow and a centrifugal pump lowered the water sufficiently to excavate by hand to bedrock, the sheeting of course being driven to follow down as the water was lowered and obstructions were removed under the sheet piles.

According to the F. W. Dodge Company's report, industrial building still maintains the lead over all other classes of construction activity with a total of $216,663,000 of contracts awarded during February in the territory east of the Missouri and north of the Ohio Rivers.

Important Steam Shovel Work

It is estimated that during the next five years at least 13,000,000 yards of earth and ore will be excavated and loaded by steam shovels in the Mesaba iron range in the Lake Superior district. There have already been installed there more than 150 steam shovels, most of them with 4-yard dippers, together with some of larger size including 360-ton machines with 6, 7, and 8-yard dippers.

These load directly into automatic air operated dump cars, which within the last two or three years have increased to 20 and 30-yard sizes. The latest designs have been considerably simplified and improved, enabling the cars to resist the tremendous impact of loads delivered from the large buckets and to be so quickly operated that, when they are keeping the 4-yard shovels fully occupied, it is estimated that the value of the excavation amounts to about $1.00 per minute; that is, about eight times the cost of the shovel running, and that the present cost of the excavation is about 35 cents per yard.

Cash Value of Accident Prevention

The California Safety News issued by the Industrial Accident Commission of California states that under ordinary operating conditions the annual compensation and medical cost for accidents and injuries to a working force of 6,000 men averages $127,200 and involves a time loss of 17,000 days. It also estimates that a maximum expenditure of $16,000 per year for safety appliances and otherwise reducing accidents and injuries will bring the compensation and medical cost down to $64,200 and the lost time down to 7,500 days, thus diminishing each by nearly one half.

Blasting a Concrete Bridge

A concrete highway bridge in Iowa was recently torn down with dynamite at a total cost of $29.50. Holes were made in the earth at the ends and the centers of each of the abutments 3 feet thick, which were each loaded with 5 pounds of 60 per cent. dynamite, and ten holes were drilled 2 feet deep in the abutment walls, each of them loaded with 1 pound of dynamite well tamped with moist clay. Several 3-pound chargers of dynamite were placed on top of the reinforced concrete floor and directly under them additional chargers were secured by mud caps; in all, 23 charges of dynamite were distributed over and around the bridge and were simultaneously fired by a blasting machine located 250 feet away. The 85 pounds of dynamite and 23 electric blasting caps used sufficed to entirely destroy the bridge instantaneously.

In the construction of the large earth dam at Englewood for the Miami Conservancy District, more than 100,000 yards of embankment were placed in one month and the materials dredged by hydraulic pumps, were delivered to their suction pipes through revolving screens that rejected oversize stones. The use of these screens instead of the square gratings previously installed has greatly increased the progress on the work and correspondingly decreased the unit cost. A record was made by pumping more than 6,500 yards of material into the dam during 20 consecutive hours.

Doubling up Bridge Trusses

Two old 100-foot single track spans on the Kansas City Southern Railroad had four-panel pin-connected trusses that were recently supplemented by the addition of two parallel duplicate trusses 37 inches on centers outside of the old trusses.

The new trusses were erected by suspension from the existing span and connected to the old trusses by diaphragms at the three intermediate panel points. New floorbeams were riveted to the bottom flanges of the old floorbeam and projected beyond the ends of the latter to engage vertical connection angles riveted to the diaphragms between old and new trusses. New lines of stringers were added and the tops of the piers were revised to receive the new trusses.

After erection was completed, transverse lifting beams engaging the ends of the new trusses were supported at one end on pier columns and at the other end on jacks seated on the old floorbeams and operated until the new trusses were deformed sufficiently to take the required load from the old trusses and were fixed in position to maintain this initial stress by shimming under the ends. In one bridge the cost of reconstruction was about $7,500 against $19,000 for an entirely new bridge.

Blue-Print Protector

A sheet of transparent sheeting—the same material used for lights in auto curtains—is cut to desired size. A piece of light-weight leather substitute is then cut about a half inch larger all around than the piece of sheeting. This extra half inch allows for a lap-over on all but the top side of the protector. A sewing machine stitches the lap down to the sheeting forming a large flat pocket, open at the top for the insertion of the blue prints.

Both the transparent front and the coated fabric back are waterproof and greaseproof. Dirt or grease may easily be wiped or washed off either without injury to the material. Both materials are flexible and the holder may be rolled up if desired in the same way an unprotected blue print is usually handled by a workman.

Based on the Dodge reports of building construction during 1919, Burley S. Ayer estimates that the building construction during 1920 will reach a value of $3,620,000 which corresponds to the progress indicated by percentages of increases of 1916, 1917, 1918 and 1919 of 117, 139 and 190, respectively, that are very close to the discount values of the actual purchasing power of the dollar in these years It does not anticipate much improvement in the shortage of materials, uncertain delivery and insufficient labor and disorganization of transportation that have constituted the most serious obstacles to construction work last year.

Good results in filling a large sewer trench in Panama were recently obtained by the use of a skeleton drag scraper operated by steam power. The scraper consisted essentially of a triangular horizontal transverse skeleton framework to which were attached four steel teeth inclined about 60 degrees with the horizontal bottom elements that prevented the scraper from digging too deeply below the surface.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

INDEMNITY AGAINST LIENS.

(N.C.) Owner of building *held* not entitled to compel surety on the bond of the contractor to erect the building to make good to it the sum it was required to pay material men on account of failure to retain money to satisfy such claims, as required by Pell's Revisal, § 2021, when settling with the contractor; the liability not coming within the bond.—Guilford Lumber Mfg. Co. v. Holladay, 100 S. E. 597.

The owner of a building, which, after notice, in violation of Pell's Revisal, § 2021, paid to the contractor to erect the building the full amount due him when he owed material men, *held* not entitled to recover from the surety on the contractor's bond the amounts it was required to pay the materialmen, since to permit recovery would be to predicate the owner's right of action on its own breach of statute.—Id.

CONTRIBUTORY NEGLIGENCE.

(Cal.App.) Where a general contractor's employe in doing his work placed a plank across an elevator shaft, he did not assume the risk of injury by the movement of an elevator operated by the employes of defendant, the contractor installing elevators, who did so without investigating his presence on the plank and without warning, although they knew other men were working in the shaft.—Fidelity & Casualty Co. of New York v. Llewellyn Iron Works, 184 P. 402.

(Cal.App.) Though one may not willfully close his eyes to danger on the assumption that another will act with care, he cannot be deemed negligent when, if a reasonable use of his faculties does not warn him to the contrary, he rests on such assumption.—Commonwealth Bonding & Casualty Ins. Co. v. Pacific Electric Ry. Co., 184 P. 29.

(Tenn.) Any negligence on the part of plaintiff contributing directly to the injury will bar an action.—Bejach v. Colby, 214 S. W. 869.

(Tenn.) Where negligence by plaintiff is remotely connected with the cause of injury, the question to be determined is whether defendant exercising ordinary care and skill might have avoided the injury, and, if so, plaintiff's remote negligence may not be set up in bar of the action, but will be considered only in mitigation.—Bejach v. Colby, 214 S. W. 869.

PROCEEDINGS TO PERFECT.

(Cal.App.) Under Code Civ. Proc. §§ 1187, 1192, where contractors did work on a building with the knowledge, consent, and permission of the owners, no notice of completion of the work having been filed, the contractors had 90 days within which to file their claims for lien.—Krenwinkel v. Henne, 183 P. 957.

(Cal.App.) Where claimants did not file their notices of mechanics' liens, either within the time limited after the notice of completion of their original contracts, their liens are not valid because of failure to comply with Code Civ. Proc. § 1187.—Pacific Mfg. Co. v. Rasmussen, 184 P. 54.

(Cal. App.) The rule under Code Civ. Proc. § 1187, as to the 120-day period after cessation of labor within which a lien claimant may file a lien does not apply where there is an actual completion, and the 90-day provision applies, not only to cases of actual completion, but also to those of constructive completion, including completion by cessation from labor, for in such case there is no completion until there has been a cessation of labor for the period of 30 days, after which the lien claimant has 90 days within which to file his lien, by virtue of estoppel because of owner's failure to file notice of cessation from labor.—Mott v. Wright, 184 P. 517.

(Ky.) A materialman's time, of 35 days from the furnishing of the last item of the material, for giving notice of lien to the owner pursuant to Ky. St. § 2463, cannot be prolonged by furnishing material that is trivial in value and not absolutely necessary for the completion of the contract, on the mere pretext that the belated delivery was caused by oversight.—Henry Koehler & Co. v. Hines, 214 S. W. 906.

(Cal. App.) Cessation from labor by reason of actual completion of a building contract is not the cessation of labor, which, under Code Civ. Proc. § 1187, relating to filing of claim, itself constitutes a constructive completion of the building or contract.—Mott v. Wright, 184. P. 517.

The rule under Code Civ. Proc. § 1187, as to the 120-day period after cessation of labor within which a lien claimant may file a lien, does not apply where there is an actual completion, and the 90-day provision applies, not only to case of actual completion, but also to those of constructive completion, including completion by cessation from labor, for in such case there is no completion until there has been a cessation of labor for the period of 30 days, after which the lien claimant has 90 days within which to file his lien by virtue of estoppel, because of owner's failure to file notice of cessation from labor.—Id.

(Cal. App.) Under Code Civ. Proc. § 1187, as amended in 1911, in action to foreclose mechanics' liens, the statement in the second claims of lien that there was no contract price, and that the reasonable price was being charged for the work done, held not a fatal variance from the first claims of lien, stating the contract was agreed upon and was payable on completion.—Krenwinkel v. Henne, 183 P. 957.

EXTINGUISHMENT, RELEASE, OR PAYMENT.

(Okl.) Where cost of building exceeded contract price, the owner defending an action to enforce subcontractor's lien, etc., was entitled to credit for his payments to contractor who paid money to subcontractors, during 60 days within which they otherwise might have filed liens, to the extent of pro rata amounts which other subcontractors, etc., would have been entitled to if their liens had been filed in view of Rev. Laws 1910, § 3864.—J. B. Klein Iron & Foundry Co. v. A. B. Mays & Co., 184 P. 577.

NEWS OF THE SOCIETIES

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 27-29.—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secrtary, John M. Diven, 153 West 71st Street, New York City.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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World's Road Congress.

Through the state department of the American Counsul General at Paris, the United States has been invited to join the permanent international association of road congresses. The Executive Committee of the American Association of state highway officials, recommends to the Secretary of Agriculture, that the invitation be accepted and Secretary Meredith concurred in this and promised to recommend to the state department that Congress be asked to authorize acceptance. The highway officials also recommended that the International Association be invited to the United States for its next meeting. Thomas H. MacDonald, chief of the Bureau of Public Roads, says that the United States is the only civilized nation not now a member of the International Association which constitutes an International Tribunal for bringing together the best experience and results in highway construction and administration. Meetings have been held in Brussels, Paris and London, but have been suspended during the war.

American Association of Engineers.

The Nebraska Engineering Society voted on March 8 to amalgamate with the American Association of Engineers. The following officers have been elected by the Los Angeles Chapter: Frank H. Joyner, president; A. L. Harris and H. Z. Osborne, Jr., vice-presidents, and R. H. Holbrook, secretary. William D. Armstrong, Myron Hunt, F. C. McMillan and F. H. Olmsted are directors.

A committee representing Engineering Council discussed the council's compensation report. This committee consisted of Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment, New York City; Colonel Bion J. Arnold, consulting engineer, Chicago, and Oscar C. Merrill, chief engineer, U. S. Forest Service, Washington, D. C.

The twenty thousand railroad professional engineers of the United States were represented at the hearing of the Interstate Commerce Commission on March 15 by a committe of the A. A. E., consisting of L. K. Sherman, president of the United States Housing Corporation, District Secretary R. C. Bailey, and C. H. Wisewell. The hearing was called in compliance with the terms of the Transportation Act to determine which employes are to be classified as "subordinate officials and other employes," and for promulgating other rules governing nominations for appointment to the Labor Board.

The A. A. E. was the only organization of professional engineers which had delegates at this meeting.

The representatives of the Railway Executives contended that all engineers should be included in the "official" group.

The Michigan Engineering Society has voted in favor of the amalgamation of the society with the A. A. E. by a letter ballot just completed. The new organization will be known as the Michigan Engineering Society.

The St. Joseph Chapter of the A. A. E. has elected J. C. Holland, chief engineer of the St. Joseph Structural Steel Company, as president; George S. Yant, valuation engineer of the St. Joseph and Grand Island Railway, and Glen B. Riddle, of the St. Joseph Structural Steel Company, vice-presidents; Clayton O. Judson, city engineer of St. Joseph, secretary, and W. B. Hazen, consulting engineer, treasurer. A. A. E. chapters have been granted members petitioning from Flint, Michigan; Corvallis, Washington; Minot, N. B., and club certificates to members petitioning from Atchison, Kansas; Boise and Idaho Falls, Idaho. The membership of the A. A. E., on March 16, was 14,100 with 6,143 applications for membership pending.

The officers elected for 1920 by the Newark Chapter are Frederick A. Reimer, president; Robert A. Meeker, Morris R. Sherrerd, David Boswell and Thomas J. Wasser, vice-presidents, and D. W. Krellwitz, secretary and treasurer. The chapter has already passed a resolution urging that a civil engineer be appointed to serve on the New Jersey bridge and tunnel commission either in an active or ex-officio capacity, not as reflecting any criticism on the existing boards or its method of work, but to insure to the board and to the people of the state full information relative to the engineering details involved in any project.

Federal Highway Council.

As the national body around which highway educational activities are now being centralized, the Federal Highway Council occupies an unique position in building for better transportation. It has a direct affiliation with more than eleven hundred organizations throughout the entire country representing the public welfare and commercial interests of millions in population. From those organizations, as their representatives, fifteen thousand nominations have already been received for membership in the Council.

In the face of high cost for both materials and labor, and the fact that in some states construction programs must be altered somewhat to meet existing labor and material conditions, there is no tendency upon the part of the people to slow down in their plans to place the nation's highways upon a higher plane in the country's transportation system.

A curious fact is that the building of roads is seriously hindered by the same evil which they are designed to remove—lack of transportation facilities. According to authoritative information, production is halted to a greater degree by inadequate transportation facilities than by labor shortage, at least in production of road building materials.

Increased Engineers' Salaries Requested.

Senator Calder of New York has proposed an amendment to the Rivers and Harbors Bill, which has passed the House and is in the hands of the Senate Commerce Committee, providing for a 25 per cent increase of salary for assistant and junior engineers and chief clerks employed in connection with the improvement of rivers and harbors or on the construction of fortifications.

Railroad Conference.

At the second annual railroad conference of the American Association of Engineers, held in Chicago on March 15, there was a decided majority in favor of an assessment of $2.00 for each railroad member to meet the expense of a national railroad secretary and a railroad department. The meeting favored the maintenance of a national railroad department under a paid railroad secretary.

A telegram was sent to the Interstate Commerce Commission asking that C. E. Lindsey, a professional engineer and a member of the Board on Wages and Railway Working Conditions of the U. S. Railroad Administration, be placed in nomination for appointment to the Railroad Labor Board provided for by the Cummins-Esch Bill. Among the addresses were those of Samuel M. Felton, president of the Chicago Great Western Railroad, who spoke on the problem of the railroads since their return to private management; George W. Hand, assistant to the president of the Chicago and Northwestern Railway, who advocated section activities which will train engineers for executive positions; W. C. Bolin, chairman of the A. A. E. sub-committee on salaries; F. H. Newell, president of the American Association of Engineers; J. B. Jenkins, valuation engineer of the Baltimore and Ohio, and F. B. Morrow, chief engineer of the Chicago and Western Indiana.

State of New York—The Civil Service Commission.

Examinations for the State, County, and Village Service, April 10, 1920, Architectural Draftsman, Grade 8, $1,501 to $1,800. Several appointments expected in the office of the Transit Construction Commissioner, New York City. Inspector of Equipment, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Open only to those who have had at least 5 years of practical car-house or car-shop experience. Inspector of Equipment (Boilers), Public Service Commission, Second District. $2,040 to $2,800. Inspector of Lumber, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Candidate must have had at least five years of experience as inspector of lumber, general foreman of a lumber company or otherwise as responsible employee in the grading of the woods. Junior Electrical Engineer, Public Service Commissions and Office of Transit Construction Commissioner. $1,501 to $1,800. Several appointments expected. Junior Engineer (Civil). Grade 8. $1,501 to $1,800. Several appointments expected in the office of the Transit Construction Commissioner, New York City. Junior Engineer (Civil), Grade 7. $1,201 to $1,500. Several appointments expected in the Office of the Transit Construction Commissioner, New York City. Application forms will not be sent out by mail after March 29, 1920. Applications received at the office of the Commission after March 31, 1920, may not be accepted.

For application form, address a postal card to State Civil Service Commission, Albany, N. Y.

Withdraw Engineers' Registration Bill.

Senate Bill No. 91, introduced in the Legislature of Virginia by the Engineers' and Architects' Association of Lynchburg, which provided for registration of professional engineers, has been withdrawn at the request of the Richmond and Tidewater Virginia chapters of the American Association of Engineers. These organizations felt that the bill was not representative of the conclusion that have been reached regarding requirements of registration bills, and have since caused the introduction of Senate Bill No. 226, which contains many improvements over the one withdrawn.

PERSONALS

Herrold, George H., Office Engineer, Department of Public Works, St. Paul, Minnesota, has been appointed Managing Director and Engineer of the St. Paul City Planning Board effective March 15, 1920. This is a newly created position brought about by ordinances providing for a City Planning Board to study the physical conditions of the City and prepare a comprehensive plan for its future development.

Randolph, Isham, of Chicago, addressed the Detroit Real Estate Board on March 11 on "The Lakes to the Atlantic Waterway."

Painter, Captain P. C., of the U. S. Army Engineer Corps, has joined the engineering staff of the eastern paving brick manufacturers association as district engineer.

Wadsworth, G. H., has resigned as assistant engineer of the California Debris Commission and has opened in San Francisco an office as consulting engineer to specialize in water utilization and flood protection.

Brunning, H. D., chief engineer of the Ohio Highway Department has resigned that position and entered the service of the Ohio Paving Brick Manufacturers Association.

Clark, Frank M. has resigned the position of superintendent in charge of paving for the Barrett Co., Ltd., Canada, and has been appointed as assistant chief engineer of the Nova Scotia Highway Department, headquarters at Halifax, N. S.

Norton, R. M., engineer of the Sacramento Co., Cal., has resigned to become engineer of San Diego Co., Cal.

Winslow, G. R., formerly first assistant engineer of the California State Highway Commission, has been appointed division engineer of Division 3.

Lau, P. M., highway engineer of Oakland Co., Mich., has resigned to undertake highway contracting work.

Wheeler, Major Robert C., until recently chief of the water supply section of the construction division of the United States Army, was discharged from the service about Mar. 1, on Mar. 3 was married to Miss Margaret Lappe, Pittsburgh, and on Mar. 16 sailed for Athens, Greece, with a party of engineers organized by Ford, Bacon & Davis, to prepare plans and estimates for the water supply and sewage of Athens.

Barker, Harry, and Wheeler, Robert C., have formed an association with offices at 170 Broadway, New York City, for the general practice of engineering. Mr. Wheeler will be in charge of the work on water distribution, sewage and collection, for the city of Athens, Greece.

Cranch, E. I., has been appointed assistant engineer of the Kansas State Board of Health.

Hayler, G. W., has accepted a position on the staff of the city planner of Boston, with headquarters at Cambridge, Mass.

Campbell, G. L., has been appointed division engineer of the Kansas State Highway Commission, at Salina, Kans.

Wilcox, John W., city engineer of Macon, Ga., died recently.

Gregory, Charles E., deputy chief engineer of the North Jersey District Water Supply Commission, died February 21 at East Orange, N. J.

Simpson, Guy Co., consulting engineer, San Antonio, Texas, died Feb. 16.

Smith, Felix R., formerly assistant engineer of Nashville, Tenn., died Feb. 12.

Beattie, W. S., city engineer of Charles City, Ia., died Feb. 7.

Sheppard, J. W., managing engineer of the Gem Irrigation District, Idaho, died Feb. 12.

Dysard, E. E., president of Dysard Construction Co., Atlanta, Ga., died recently.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Installations

Giant Precast Piles.

Giant piles designed to be efficient under heavy driving have a rectangular concrete cross section reinforced by four full length bars having their lower ends hooked into the web of permanent cast iron points made with a flange at the top to give bearing for the lower ends of a detachable steel driving frame that encloses the pile shaft and receives the hammer impact.

Piles of this type, 16 inches square, were driven without injury through 2 feet of earth, 4 feet of brickwork, 14 inches of solid pine timber, 24 inches of brickwork and 10½ feet of stiff blue clay and sticky blue sand to a refusal of ¼ inch under 60 blows of a 7,500 pound Warrington steam hammer with 48-inch stroke. Under New York building regulations, these piles were good for loads of about 65 tons each.

New Battery Charging Outfit.

A small portable battery charging outfit has recently been placed on the market by the Westinghouse Electric and Manufacturing Company for charging automobile batteries from an ordinary alternating-current house lighting circuit. It is rugged, reliable and of simple construction. It has no moving ports; uses no oil or grease, and is not affected by heat or cold. The principal parts of the outfit are a transformer, a rectifier bulb, and a fuse for protecting the apparatus.

The outfits are designed to give rated amperage at normal line voltage to three cells, and about two-thirds this current at normal line voltage to six cells. They are furnishd in two sizes, one with a direct-current rating of 2½ to 1½ amperes and a larger size with a d. c. rating of three to six amperes. The approximate net weight of the smaller outfit is 9¼ pounds and that of the larger, 21 pounds.

Centrifugal Pumps.

The Dayton-Dowd Company announces the opening of a branch office in Cleveland, Ohio, under the management of Mr. L. E. Maher of the Maher Engineering Company, of Chicago.

Portable Air Compressors.

The Ingersoll-Rand Co. has recently put on the market the new Imperial type 14 portable compressors in two sizes, one having a capacity of 118 cubic feet and weighing 400 pounds and another of 210 feet weighing 600 pounds. They are especially designed for lightness, strength, durability and efficiency, and are wholly self-contained with long stroke gasoline driving motors operating at medium speed. They are water cooled and are equipped with automatic governors maintaining constant speed under all working conditions and preventing over speed when idle.

Dump Wagons.

Studebaker, South Bend, announces the sale of its dump wagon business to the Western Wheeled Scraper Co., Aurora, Ill., who will continue the manufacture of Studebaker model dump wagons and will furnish extra parts and repair parts on order. Studebaker will specialize in farm wagons which will receive the full benefit of their 67 years' practical manufacturing experience.

Mechanical Memory.

The Mechanical Memory System Co., Aurora, Ill., are the manufactureres and distributors of a visible controlled system calculated to provide for the manager's desk a mechanical memory and to afford at all times a visible schedule of pending work. Complete information describing the method of operation will be mailed on request.

United States Locomotive Cranes.

Bulletin 190 of the United States Crane Company describes 20-30-ton locomotive cranes with booms 40, 45, 50 and 55 ft. long that are equipped with grab buckets, blocks or magnet. The shipping weight is 120,000 pounds, fuel and water supply, 9,000 pounds, ballast, 30,000 pounds. The engines are of vertical type with 10-inch double cylinders of 10-inch stroke and the 54-inch vertical boiler is 9½ feet high with 124½-inch tubes carrying 125 pounds steam pressure and having a great area of 12½ square feet and a grate surface of 550 square feet. The draw bar pull is 9,000 pounds approximate, and the hoisting speed is 280 feet per minute single line, with engines running 300 R.P.M. The swinging speed is 3 revolutions per minute and the travel speed 600 feet per minute. The cranes can operate on a maximum grade of 6 per cent without a train load and can pass around a 60-foot curve. The lifting capacity without track clamps or outriggers is 20 tons at 15-feet radius or 4 tons at 50-feet radius. The tipping load is 35 per cent higher than the safe load.

Leader Crawler Tractors.

These tractors are recommended by the Dayton-Dowd Company for road work on account of their great power, light weight, durability and flexibility. They are made in two sizes and burn from 18 to 30 gallons of kerosene oil daily. They are built with two light smooth face front wheels and are mounted in the rear on a four-wheel truck with caterpillar traction, and Hyatt roller bearings. They have a forward and reverse speed of 2 miles and a high speed of 3¼ miles per hour; transmission is of the automobile selective type with sliding gear. All gears are of cut steel and the heavy channel bar frame is heavily braced and trussed. Both sizes have a 98-inch wheel base and a shipping weight of 6,200 pounds or 6,500 pounds.

Scoville Pump Valves.

The important features in the desige of these valves, sold by the Richardson-Phoenix Co., are the employment of a compressible material to seal the metal valve and the elimination of valve resistance and disturbance of fluid, thus maintaining a uniformity of flow. The principal advantages claimed are the strength to withstand pressure and wear, elimination of leakage and slippage, proper spring tension, an uninterrupted fluid flow and elimination of eddies, and low cost of renewals and ease of repair.

Sealing is not produced by the valve seating directly on the rings, but by the pressure of the fluid forcing the rings against the beveled edges of the vales. The springs are of phosphor bronze wire and the seat ports are straight. Renewals involve only the purchasing of a new set of seals about once a year.

During Feb. 1920, the American-La France Fire Engine Co. made 38 sales of apparatus, including pumping engines, simple combinations, and service trucks that were shipped to 15 different states and to Japan.

PROBLEMS CITIES ARE STUDYING WITH EXPERTS

Elmira, N. Y., has held a public meeting under the auspices of the Business Men's Association to discuss the adopting a CONCRETE ARCH TYPE OF BRIDGE at Main street, where the subject was presented by B. H. Davis, New York, concrete bridge specialist.

Metcalf & Eddy, consulting engineers of Boston, have been engaged by the Syracuse intercepting sewer board to go over plans for the SEWAGE DISPOSAL PLANT which the board plans to put up here within the next two years.

The plans, on which Glenn D. Holmes, the board's engineer, and Henry C. Allen, city engineer, collaborated, are now ready for approval. In the meantime sewage will be concentrated at a point on the lakeside and dumped into the lake.

A $5,000,000 structure to be known as the Peace Memorial Bridge, across the Niagara river from Buffalo to Fort Erie, has been proposed and Congress has appointed a committee to investigate its cost and commercial possibilities.

In accordance with a plan promoted by the governors of several western states, there has been prepared a congressional bill authorizing the appropriation of $250,000,000 for the reclamation of arid lands.

Pryor Creek, Okla., will construct on Grand river a water surface PURIFICATION PLANT AND ELECTRIC PUMPING EQUIPMENT with 8 miles of transmission line at an expense of about $75,000. The consulting engineers are V. V. Long & Company.

Cedarberg, Wis., has made surveys for the construction of a WATERWORKS AND SEWERAGE SYSTEM. W. G. Kirsthoffer, engineer. The cost is estimated at nearly $200,000.

St. Louis, Mo., plans the extension of the urgently needed HARLAN CREEK SEWER at a cost estimated by W. W. Horner, engineer of the Board of Public Service at $300,000.

Plans for the Bell City DRAINAGE DISTRICT No. 1 have been completed by Shultz & Sons, Lake Charles, La. Bonds for $225,000 will be issued.

The Burlington, N. J., common council has appointed a committee to make an investigation as to the advisability of purchasing the plant of the Burlington Sewer Co. and making it one of the city's assets.

The cities of Newark and Elizabeth are participating in conferences with the chief engineer of the Jersey Central Railroad on the construction by the latter of a new bridge across Newark Bay.

INDUSTRIAL NEWS

Standard Specifications for Concrete.

The joint committee on Standard Specifications for Concrete and Reinforced Concrete has just been organized. The committee consists of five representatives from each of the following organizations:

American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering Association, Portland Cement Association, American Concrete Institute.

The purpose of the committee is to make a thorough study of all available data on the subject of concrete, concrete materials and reinforced concrete and to incorporate the most modern information and experience into a general specification which may serve as a pattern for detailed specifications for specific types of concrete constructions.

The organization meeting of the committee was held at the Engineers' Club, Philadelphia, on Feb. 11. The following officers were elected:

R. J. Humphrey, chairman, Philadelphia; J. J. Yates, vice-chairman, New York City; D. A. Abrams, secretary-treasurer, Chicago.

The following committees, consisting of five to seven members each, have been organized:

Concrete materials, metal reinforcing, proportioning and mixing, forms and placing, design, details of construction, waterproofing and protective treatment, surface finish, form of specification.

A number of the committees have organized and are actively engaged in the preparation of their preliminary reports. The next meeting of the committee will probably be held at Asbury Park, N. J., about June 22, during the annual convention of the American Society for Testing Materials.

Standard Steel Buildings.

The Blaw-Knox Company of Pittsburgh, Pa., have purchased the C. D. Pruden Company of Baltimore, Md., who are manufacturers of standardized steel buildings for industrial plants, warehouses, cottages and garages.

Campbell, J. Grier, purchasing agent of the Blaw-Knox Company, has resigned to become assistant treasurer of the C. D. Pruden Company.

Boyd., Wm. S., formerly assistant purchasing agent of the Crucible Steel Co., and purchasing agent of the Page Steel and Wire Co., has been appointed purchasing agent of the Blaw-Knox Company.

Henry Exall Elrod Company, general and consulting engineers, Dallas, Tex., has issued a very handsome illustrated booklet describing the personnel and work of the organization. Besides Mr. Elrod, the organization includes David Brennan, Frank W. Chappell, John J. Barlow, Alexander M. Vance, Dudley M. Wilson, Robert E. Schiller and Jack T. Nash. The training and experience of these men are described.

Maher Engineering Company Opens Cleveland Office.

The Maher Engineering Company, located at 30 N. Michigan Boulevard, Chicago, announce the opening of a branch office at 708 Schofield Building, Cleveland, Ohio, handling the distribution of Erie Engine Works, constant and variable speed, high and low pressure engines; Dayton-Dowd Company centrifugal pumps and centrifugal fire pumps; Galland-Henning Mfg. Co. hydraulic balers and presses. The office will be under the management of Lincoln E. Maher.

Mack Has New Cincinnati Branch.

The International Motor Company of New York, manufacturers of Mack Trucks, announces the opening of another branch at 1426-28 Central avenue, Cincinnati, Ohio. The branch will operate under the name of the Mack-International Motor Truck Corporation, superceding the James Kidney Company who were Mack dealers in that territory. G. K. Ross will be in charge.

The Law of Government Contracts.

By R. Preston Shealey, of the Bar of the Supreme Court of the United States, Ronald Press. Part I contains chapters on Comparison of government and individual contracts, classes of contracts, and when a government contract is valid; Part II, Implied contracts; Part III, Performance; Part IV, Breach, and Part V, Procedure, and an Appendix.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, APRIL 3, 1920 No. 12

Storm King Highway

Construction of a three-quarter-million-dollar road about four miles long. Scenic and commercial route terraced in previously inaccessible steep rocky faces of two rugged mountains where vertical cuts 170 feet deep were blasted directly over the West Shore railroad tracks to secure a narrow roadway without bridges or tunnels 400 feet above the Hudson river. .Design materially modified as work progressed to utilize conditions disclosed by construction developments. Drills installed on suspended platforms; operated by men on life lines. Cement carried up roadless cliffs on men's shoulders. Massive, high, retaining walls with deep foundations were necessitated by steep slopes and decomposed rock. Precarious conditions made handwork preferable to blasing in many places. Materials and supplies were sometimes delivered by very expensive stone-boat hauling.

The Storm King road, officially known as State Road No. 5498, is 4.03 miles long from West Point to Cornwall and its completion will save a detour of 12 miles now necessary in driving between these two points, thus filling an important traffic need at the same time that it will provide one of the grandest and most beautiful scenic routes in the country and afford an example of successful construction under excessively difficult, dangerous and costly conditions.

COST AND CONTRACTS.

The portion of the road considered in this description is being built at an estimated total cost based on the computed quantities of the contracts, plans and specifications, of $717,583. The impossibility of making accurate preliminary measurments at some locations and the unknown character of the rock to be encountered in the most difficult sections, have resulted in a large increase of some of the originally estimated quantities so that the ultimate cost of the work, including the preliminary surveys, may perhaps equal or exceed a total of $850,000, a very large proportion of which will have been expended on a section of the road about 2,000 feet long located on the nose of Storm King Mountain.

STORM KING, SHOWING LOCATION OF HIGHWAY.

The work was designed and its construction is directed by the New York State Highway Commission—Frederick Stuart Greene, commissioner; James H. Sturdevant, division engineer; E. J. Howe, resident engineer in charge of construction, and Theodore Fenner, assistant engineer at the site.

The execution of this work has long been planned and although two successive contracts were let several years ago, no work was accomplished until after July 30, 1915, when a contract was awarded to the John L. Hayes Construction Co., Yonkers, who executed about $264,000 worth of work before the difficulties and interruptions due to war conditions and subsequent legislation caused the cancellation of the contract on May 23, 1919. In July, 1919, bids were opened for the completion of the work, and the John L. Hayes Construction Co., being again low bidder, was awarded the contract at a unit price sum of $453,583, since which time work has been in active progress and it is hoped will be completed in 1921.

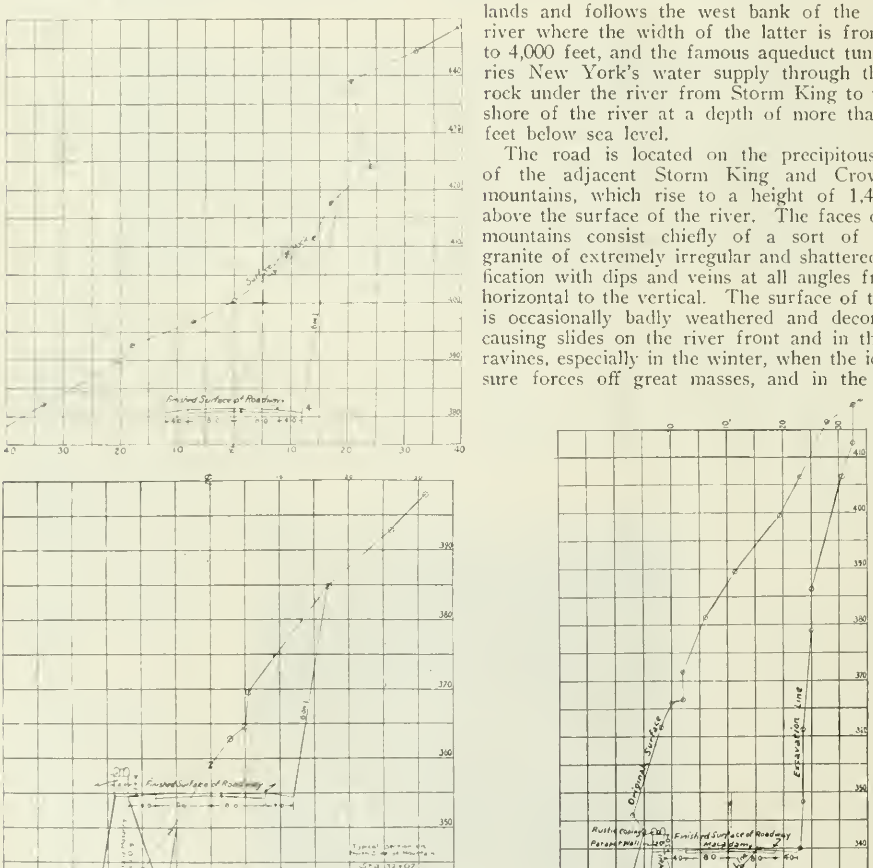
On December 1, 1919, the engineer's estimate showed that about 40 per cent of the total work had been completed and, the more difficult parts having been well advanced, it is expected that the remainder of the work will be finished as rapidly as the weather and labor conditions permit, the situation being so exposed and the climate so rigorous that only a small proportion of the work can be done during the winter months.

While construction was in progress on the first contract awarded, the work was illustrated in the *Municipal Journal*, Aug. 23, 1917, volume 43, page 169, where the general conditions and preliminary operations were described at greater length than in the present article. At that time work on the very steep rock slopes was usually commenced by drilling and blasting a line of jackhammer holes across the top of the cut to form an initial narrow bench or terrace. This operation was repeated down to an elevation 15 to 25 feet above grade. Afterwards the cut was widened by blasting successive rows of holes, the first of which was spaced far enough back from the face to insure the shattering of the rock with minimum displacement, thus forming a buffer that retained the material excavated above it so that it was available for use in fills.

GENERAL DESCRIPTION.

The road is at the north end of the famous Highlands and follows the west bank of the Hudson river where the width of the latter is from 3,000 to 4,000 feet, and the famous aqueduct tunnel carries New York's water supply through the solid rock under the river from Storm King to the east shore of the river at a depth of more than 1,100 feet below sea level.

The road is located on the precipitous flanks of the adjacent Storm King and Crow Nest mountains, which rise to a height of 1,400 feet above the surface of the river. The faces of these mountains consist chiefly of a sort of bastard granite of extremely irregular and shattered stratification with dips and veins at all angles from the horizontal to the vertical. The surface of the rock is occasionally badly weathered and decomposed, causing slides on the river front and in the steep ravines, especially in the winter, when the ice pressure forces off great masses, and in the spring,

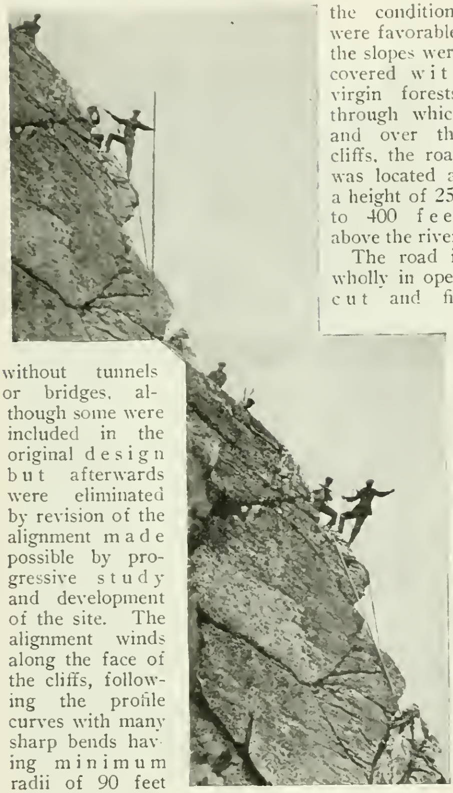

Finished Surface of Roadway
440
430
420
410
400
390
380
40
30
20
10
10
20
30
40
Finished Surface of Roadway
390
380
370
360
350
340
330
Typical Section on Station 32+07
Original Surface
Excavation Line
Rustic Coping
Parapet Wall
Finished Surface of Roadway
Macadam
Stone Masonry Laid in Mortar
Excavation Line Wall Footings
410
400
390
380
370
360
350
340
330
320

THREE CROSS-PROFILES, SHOWING ORIGINAL SURFACE AND FINISHED ROADWAY.

when freshets undermine and wash away large quantities of material.

Small amounts of earth and debris that have accumulated on the shelves and in the crevices of the rocks afford footholds for trees and shrubs and wherever the conditions were favorable, the slopes were covered with virgin forests, through which and over the cliffs, the road was located at a height of 250 to 400 feet above the river.

The road is wholly in open cut and fill without tunnels or bridges, although some were included in the original design but afterwards were eliminated by revision of the alignment made possible by progressive study and development of the site. The alignment winds along the face of the cliffs, following the profile curves with many sharp bends having minimum radii of 90 feet and with alternating grades up to a maximum of 7 per cent.



SURVEY PARTY TAKING CROSS-SECTIONS.

The plans and specifications call for a minimum width of subgrade in cuts of 24 feet, and 26 feet for the tops of embankments. The location was determined so as to promixately equalize the yardage in the excavations and in the embankments, but so much material was lost in building on steep slopes, even with the most careful kind of blasting, that it has been necessary to procure a considerable amount of embankment material from borrow pits with a maximum haul of about 1,200 feet.

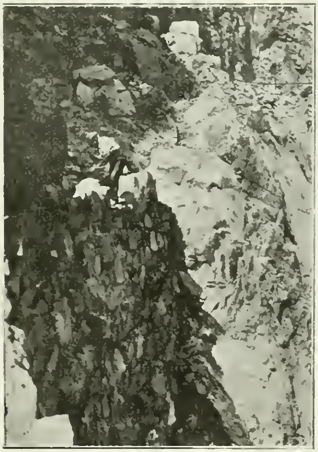
ENGINEERING CONDITIONS.

On account of the unusual conditions and great difficulties and expense of construction, the engineers were allowed exceptional latitude in the final location, thus giving the road a considerable flexibility and enabling considerable reductions in the amounts of work by comparatively slight deflections of the road, as the actual construction work developed new or unsuspected conditions whereby cost might be increased or diminished according to the position.

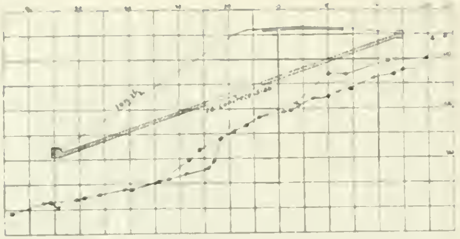
Ordinarily the location was only shifted a few feet transversely, but notwithstanding the exercise of the greatest care and judgment, some of the final quantities necessarily involved in the construction were three times as great as those of the original estimates. Irregular stratifications, steep slopes, the decomposition due to weathering of the surface and to the penetration of rain, snow, and ice in the crevices and the occurrence of many inclined veins, some of them filled with quartz and some with soft material, made the condition of the rock on the surface and for depths of sometimes 10 or 15 feet especially dangerous, uncertain, and costly to handle.

CHANGES DURING CONSTRUCTION.

When excavation was actually commenced, the conditions were sometimes found to be much different from what the original survey and inspection had indicated, and the excavation often proved to be deeper and much more costly than anticipated. More accurate information regarding the character of the rock showed that parts of the original alignment and structures could profitably be modified in some important cases. In one place early developments permitted the elimination of a bridge of about 200 foot span, the necessity for which was obviated by carrying the road through a cut that was not at first considered practicable. In another place a difficult and expensive cut was substituted for a short tunnel section because it became evident that the character of the rock was so treacherous that great danger would be involved in an attempt to excavate the tunnel, the stratification and dip justifying the fear that the roof and walls of the tunnel might slide bodily forward into the tunnel; a possibility that was confirmed by the experience of acqueduct engineers and their observations in the construction of a tunnel deep under the river bed at a point not far distant, where the same characteristics of rock were observed.



MASON LAYING RETAINING WALL.



CROSS-SECTION OF CULVERT ON STEEP SLOPES.
The concrete slab shown forms the top of the culvert.

EXCESS EXCAVATION AND MASONRY.

In many cases where a comparatively small amount of excavation would have sufficed for terracing the road bed on the slope if the latter had been composed of sound, stable rock, it was found necessary to remove not only the loose rock, but some of the ledge rock to a distance of 10 or 15 feet or even more in direction perpendicular to the slope, and for a long distance parallel with the slope, to secure stable conditions. In other cases the removal of the rock directly involved in the proposed cut left large masses of ledge rock in a more or less unsound condition overhanging the roadway on account of the blast and cleavage having followed the inclined strata and the removal of these threatening masses involved an unexpectedly large amount of material sometimes extending up the mountain side to a considerable height.

It was usually necessary to protect the river side of the roadway by a massive retaining wall, of gravity section, from 20 to 50 feet high. The foundations of these retaining walls were always carried down to horizontal or offset footings in the rock, sometimes at a depth of 10 or 20 feet below the surface, and involved another large amount of difficult excavation, much of which could not be anticipated in the original estimates.

All of these conditions prevailed to increase the amount, difficulty and expense of excavation, especially in some of the cuts which attained a maximum depth of 170 feet in extreme cases where they followed the very steeply inclined surface of the rock and necessitated the removal of a comparatively thin mass of material approximately parallel to it.

SPECIAL EXCAVATION METHODS.

A large portion of this rock consisted of detached masses with dimensions up to 10x15x25 feet and loose boulders up to 25 tons weight. These were block-holed with jack hammer drills and blasted with great caution so as merely to split them up with a minimum displacement. In many places care was taken to lift the shattered rock from its original position and carefully deposit it in a stable position on the slope by means of derricks rather than permit it to fall down the mountain side. So far as possible, a narrow shelf or terrace was first provided, the face of the cliff blasted, and the shattered rock received and retained on the shelf until it could be moved to a safe position or placed in walls by the derricks.

TRACK PROTECTION.

In many places, especially for a considerable distance on the face of Crow Nest mountain, nearly all the rock that rolled down the mountain was likely to fall onto the double tracks of the West Shore Railway located on the river bank close to the surface of the water. Great precautions were therefore taken to safeguard the railroad and traffic; the tracks were constantly patrolled and telephone stations were established communicating with the working parties on the mountain sides above, with the engineer's offices, and with the train dispatcher's office, and blasting was not allowed except at times designated by the railroad authorities when no trains were allowed on this section of the track.

BARRIER TO KEEP STONES OFF OF RAILROAD TRACK.

It was at first required that the contractor should maintain a locomotive derrick on the tracks ready to remove obstructions immediately should they occur, but it was found that getting the derrick car on and off the main lines of tracks took so much time that the obstruction to the traffic was greater than that which was due to removing the rocks by hand, and the derrick car was therefore superseded by hand work. Care was also taken to use still smaller charges in blasting the rock above the tracks so that there was less danger of large quantities of rock falling on the tracks.

SAFETY BARRIER.

At one of the worst places the track is protected, as required by the contract and specifications, by a wooden barrier built between it and the foot of the cliff. This barrier is virutally a vertical bulkhead about 20 feet high and 140 feet long, made with 2-inch horizontal planks, spiked to vertical posts about 4 feet apart, which are strongly framed to horizontal sills and double inclined braces, somewhat faintly shown in the photograph. This barrier was built as close as possible to the track beyond the ponts where the large stones falling from the mountain sides struck the ground at the bottom of the cliff, and served a useful purpose in preventing most of the bounding and ricochetting pieces from striking the trains or falling on the tracks. In some cases, however, stones broke through the planks and sometimes even destroyed the heavy timberbents.

Just above this point, on one occasion, a piece of rock weighing about 600 lbs. was blasted from the cliff at a height of about 300 feet above the tracks and was thrown 1,200 feet horizontally, falling squarely on top of a telegraph pole.

CLASSIFICATION OF COSTLY WORK.

Under such conditions the contractor and engineers wisely preferred to loosen and displace as much of the rock as possible by barring without blasting. The difficulty and expense of the work was recognized in the specifications, where special classification of rock is made and three different prices are permitted according to the locality in which the work is done. In one section of the highway 100 feet long, there will be excavated 14,000 yards of rock at a contract price of $6 per yard, which is believed to afford the contractor little if any net profit.

END VIEW OF A RETAINING WALL.

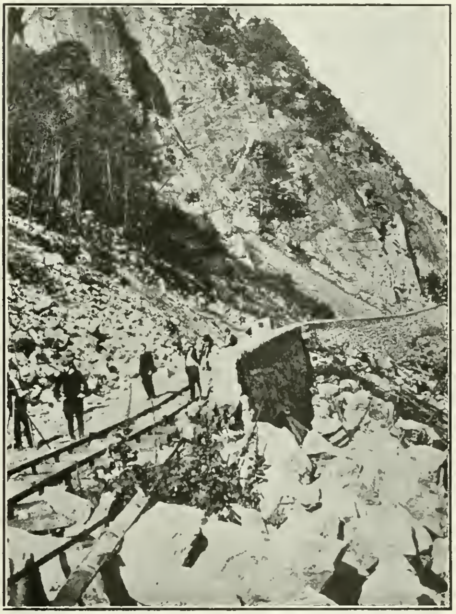
Up to the present time it has been possible to make advantageous use of a steam shovel for excavation at only one point, accessible from the south of the road, where a steam shovel was brought in at grade and excavated 25,000 yards out of 35,000 yards total. Between stations 65 and 68, a very heavy fill was required, about 20,000 yards of which had been derived from the adjacent cuts before Nov. 1, 1919. This work was commenced in 1917 and on June 5 a steam shovel was located in a borrow pit nearby delivering materials to skips on service cars that were dumped by a derrick installed at the top of the fill. On Nov. 1, 1919, 36,000 yards of material had been placed in the fill and 10,000 yards more were required.

DELIVERY OF MATERIALS.

At the commencement of construction operations, no part of the location was accessible by wagon roads except a short length at each end where trucks with moderate loads could be hauled to grade, and at one intermediate point between the two mountains where it was possible to haul very light loads over a long route from the nearest road on the high land west of the highway. The rest of the alignment was so inaccessible that in many places it was almost impossible to make the preliminary inspection and survey and the daring engineers were obliged to let themselves down the almost vertical slopes of rock by means of ropes attached to their belts. They were provided also with hand lines and ladders and required extra long levelling rods to secure readings on inaccessible points. Notwithstanding all of their precautions, one man fell from a great height on account of the breaking of his safety rope.

In order to expedite the work by commencing it at intermediate points, there were eventually located or developed three footpaths or trails from the water's edge to grade and on two of them it was possible to haul stone boats drawn by horses or mules.

For a considerable distance, especially over these paths, such light plant and materials as were indispensable were hauled to the roadway at great cost. Bags of cement were carried down the river and stored near the water's edge. In one place where two mules could be used they hauled loads of three to five bags placed on stone boats and in another place where only one animal could be used the load consisted of one to three bags. Where no animals could be used, half and quarter bags of cement were carried upon men's shoulders, thus making



ROUGHLY GRADED ROAD, RETAINING WALL, AND PARAPET WALL EXTENDING IN THE BACKGROUND.

the cost of delivering cement from the water's edge to the highway frequently five times as great as the original price paid to the manufacturer.

In some places sand was delivered in the same way as cement, and consequently every effort was made to utilize all deposits of suitable sand found near the grade and the engineers facilitated the work as much as possible by liberal decisions regarding the acceptability of the sand as determined by field tests.

INSTALLATION OF PLANT.

The contractors succeeded in installing two 20 h.p. steam boilers and four hoisting engines, two of them operated by compressed air, at intermediate points of the work and also delivered there five wooden derricks, one of them being operated by a hand windlass. Steam coal delivered by stone boats cost about three times as much at the job as it would on accessible work.

The use of an aerial tramway was investigated and estimates showed that a cableway about 1,200 feet long, to serve one of the more inaccessible portions of the line, would cost about $2,000 and the expense of installing it and moving it several times from position to position as the work advanced would be prohibitive. The idea was therefore abandoned and plans have been made for a gravity service road to handle spoil and concrete, by which the loaded cars will go down the incline by gravity and be hauled back empty or full by a hoisting engine.

DRILLING AND BLASTING.

A steam driven Ingersoll air compressor with capacity of 2,600 cubic feet of free air per minute has been installed by the contractor at the old shaft used for the construction of the water supply tunnel under the river. Air at 95 pounds is delivered through a 6-inch main laid alongside the West Shore railroad track from end to end of the section, and with its 4-inch and 2-inch extensions and branches has an aggregate length of six miles of pressure pipe. This delivers air to the work at a reduction of only about 5 pounds from the 90 to 95-pound pressure automatically maintained at the station. As the branches are carried up the mountain side on a very steep slope, no difficulty is experienced from condensation water collecting or freezing even in the coldest weather. Simple, effective traps have been secured by the insertion of short lengths of 6-inch pipe with blow-off valves to dispose of any water collecting in the line.

From a small dam built by the contractor far back in one of the ravines, water is delivered along the line in a 1-inch pipe that provides amply for the consumption of about 160 barrels daily.

The air supply is considered sufficient for 40 jackhammer drills, provided no other use is made of it, but a considerable amount is required for the operation of the hoisting engines and drill sharpeners, enough, however, remaining for the 10 to 20 jackhammers that are used to the exclusion of tripod drills. The jackhammers are found very efficient, and drill holes to a depth of 10 feet without difficulty and to a depth of 16 feet when necessary. These drills are operated in many cases by men working on painters' scaffolds suspended on the face of the very steeply inclined or even vertical cliffs and reached by ladders.

MASONRY AND CONCRETE.

The retaining walls, of which there will be about 10,050 lineal feet, containing about 26,800 cubic yards, are chiefly made of rubble masonry laid dry with footings of masonry laid in cement, and are 2 feet thick at the top at grade, with the outer face battered 1 on 6, and the inner face battered 1 on 3. Their height varies from 5 to 50 feet and they are surmounted by a parapet wall 2 feet thick and 3 feet high, with rustic coping, which is made of large stones laid in cement mortar. The walls are carefully built with stones up to 2 yard size handled by movable stiffleg derricks equipped with steam, and air driven hoists. In some places the spaces were so narrow that the derrick sills were supported at one end on the top of the wall and at the other end on the face of the cliff.

Some of the retaining walls with a 1 on 12 batter are made of rubble masonry laid in cement and all of the culverts, which have dimensions up to 10 feet wide and 15 feet high, are made with cement masonry walls covered with roof slabs of reinforced concrete. Concrete is also used for face walls at both ends of the culverts. Many of the culverts are built on inclines sometimes sloping as much as 45 degrees from the horizontal.

PROGRESS UNDER DIFFICULTIES.

Construction is now being carried on at both ends of the road and at four intermediate points, involving a force which has at times reached a maximum of about 150 men, but during last season averaged about 100 men, who were experienced on this job and worked with confidence and considerable efficiency under the very difficult conditions. Most of them are of American birth and it is significant that they refuse to work with men that fail to exercise proper carefulness.

In very hot weather the sun is reflected from the surface of the water and from the face of the mountain and the heat is so intense that it is sometimes impossible for the men to work after 9 o'clock in the morning.

In the winter the cold is sometimes extreme, the winds are strong and the steep rocks very slippery from snow and ice, so that work is suspended in many parts of the line, although some sheltered portions permit excavation and draining to be carried on practically without interruption. Most of the work is exposed to very high winds and in one place between the two mountains, where it was anticipated that the Storm King mountain would prove an effectual shield for the fierce north winds, it was found that these winds were deflected against the face of the Crow Nest mountain and produced equally strong winds from the south.

Considerable of the difficulty experienced was due to the springs and small streams encountered, and pains were taken to drain them to avoid the danger and inconvenience of water collecting in the excavations, and particularly to prevent the formation of large icicles liable to fall without warning at any time with possible fatal consequences. All of the retaining walls are pierced at intervals of 10 feet with 4-inch tile drain pipes providing weep holes to prevent the accumulation of water behind the walls.

The principal quantities involved in the total work include:

Earth and loose rock excavation	129,561	Yards
Ledge rock excavation	100,840	"
Masonry—parapets, culvert walls, etc.	4,748	"
Masonry—retaining wall laid in mortar	8,252	"
Masonry—retaining wall laid dry	18,552	"
Special guard railing	9,720	Feet
Macadam, including top and bottom courses	6,450	Yards
Bituminous Material	77,200	Gallons
Protection of West Shore Railroad property	$19,076	

Maintenance of Public Highways

The effect of each kind of construction or resurfacing on the future cost of maintenance should be studied in advance. Foundation and wearing surface should both be adapted to the traffic which the road will carry—which is not necessarily the present traffic.

By Clarence D. Pollock

It is well to ponder carefully the remarks of Col. William D. Sohier of Massachusetts at the meeting of the American Association of State Highway Officials at Louisville, Ky., recently. He stated emphatically that the older literature on highway construction would answer many of the questions which were apparently being newly raised. Col. Sohier's remarks also apply to many street paving matters which are being brought up again.

UNECONOMICAL TREATMENT OF OLD BLOCK PAVEMENT.

In this connection it is curious to note the tendency at the present time of some of the newer paving and road engineers to experiment with surfacing old brick and stone block pavements with bituminous materials of one kind or another. The older paving men will readily recall the resurfacing of old block pavements twenty to twenty-five years ago. About 1896 and 1897 the old city of New York went wild over this method when sheet asphalt pavements were laid at a very low cost. No thought was taken of the cost of maintenance, but the whole idea was to lay a big mileage of smooth pavements. This gave a great yardage at a low first cost, but it was not long before the maintenance cost was large. The foundation was not sufficiently stable even for the traffic of that period and a great point of weakness was in the matter of openings. There was no chance to bond the foundation over the opening, with the adjacent foundation. Settlements inevitably developed over the cuts and the adjacent foundation would also sink towards the sunken patch. This burying of the old material not only provided a poor foundation, but was also a waste of usable old material in most cases.

If the old pavement consists of granite blocks, the blocks can usually be recut and paved on a concrete foundation, making a first class heavy-traffic pavement at a considerable saving over new blocks. If the blocks are not fit for recutting, they may be crushed for broken stone for the concrete foundation, as is true of other stone blocks. In the case of an old brick pavement, the better bricks can be culled out and used in side streets. Even if an old stone block or a brick pavement has a concrete foundation underneath, it makes a poor foundation for a bituminous surface. When a cut in the pavement is made, the middle layer of the sandwich is loose and affords no bond for the foundation placed in the cut and settlement will surely occur around the edges of the cut.

MAINTAINING STATE HIGHWAYS.

In constructing the great mileages of State highways, far too little thought has been given to the maintenance of these road surfaces. The main idea has been to lay mileage and cover the greatest amount of ground without thought as to the future. This has resulted in the laying of great lengths of unsuitable pavements which soon are destroyed under the severe traffic and must be reconstructed at the end of three to four years in many cases. Sometimes these short-lived pavements have been paid for by 50-year bonds. It would be far better to lay a much less mileage upon a substantial concrete foundation. Then this base could be regarded as the permanent portion of the pavement and the surface the temporary sheathing, which should be of such material that it will stand the traffic to be expected for a resonable period.

With the great amount of state road surfaces already constructed of materials which are only suitable for very light traffic, it will be necessary to have extensive organizations for maintaining them properly. There is nothing to which the old saying that a "stitch in time saves nine" applies more than to road surfaces and pavements, and yet it is so often neglected. A road surface is allowed to go until it is often necessary to entirely resurface it to put it into passable condition. There is no economy in this.

One trouble has been that the roads in many cases have been constructed of material that might have been suitable for the present traffic in its bad condition, forgetting that much greater traffic will be attracted to the road after it has been improved. While in many cases it will be better to rebuild present improved roads as soon as the money is available in order to have a material which will be economical to maintain; yet in many other cases a proper organization to patrol and repair the present surfaces promptly when signs of wear first appear will be absolutely necessary in order that the maintenance cost may be kept within reasonable limits and traffic may be carried with moderate maintenance cost on the vehicles used. It must be borne in mind that the excessive cost of repairs to the road when its maintenance has been neglected is only part of the cost to the public, as the bad condition of the road pavement is quickly reflected in the cost of wear and tear and accidents to the vehicles using the highways.

ADAPT FOUNDATION TO TRAFFIC.

While desiring to emphasize the importance of building a good foundation for all state roads having heavy traffic, we do not wish to be misunderstood as to the necessity of this in all cases. Of course there are many roads where the traffic may be heavy in number of vehicles, but the unit loads may be light. In many such cases it is not necessary to go to the expense of a concrete foundation, but broken stone or the like may serve sufficiently well. However, the organization should be large enough and have sufficient engineers of experience in it, so that proper study may be made of each road before the material is selected. In this way excessive maintenance costs may be saved. In the past the work of most of our states has been carried on by much too small a force of engineers and consequently it was impossible to make a study of the conditions surrounding each road. With the large amounts to be expended on highways in this country during 1920, together with the shortage of labor and cars for transportation of materials, it is especially important that careful studies be made before letting contracts, as mistakes will involve much greater waste of funds than formerly.

FIT THE BOND TO THE ROAD.

It is pleasing to note that the state highway commissioner of Pennsylvania has ruled that the counties cannot use money from longtime bond issues for anything except the more permanent types of pavement on the state and county highways. The old methods of paying for water-bound macadam and the like by 50-year bonds, as has been done in New York State, is very expensive and wholly wrong—it soon becomes paying for "dead horse" with a vengeance. Funds from long-term bonds should be used only for constructing the more durable types of roads. The pay-as-you-go policy is the correct one for the lighter forms of construction which may be suitable on the secondary roads.

ROAD MAINTENANCE ASSOCIATIONS.

It is a noticeable fact that associations of all kinds have been formed to push certain roads and trails and to obtain money for them, but their efforts then cease. There would seem to be a big undeveloped field for civic associations to follow up the maintenance of these roads after obtaining them. We would suggest the desirability of providing an adequate maintenance fund at the time of securing the construction fund, especially in cases where the highway is to be in the nature of a memorial. In this way the memorial could be put on a permanent basis and besides, the providing for the future maintenance would be likely to compel more careful consideration of the materials to be selected in its construction in order that the maintenance fund should be ample to keep the road surface in good condition continuously. In other words, it is likely that, with a definite maintenance fund provided, it would insure a more careful engineering study of the conditions affecting the road before deciding upon the materials to be used in its construction.

Concrete Plant in Old Canal Bed

A dry canal bed at Nashua, N. H., was very efficiently utilized by the Aberthaw Construction Co., Boston, for the installation of a concrete plant and the apparatus for unloading, storing and transporting aggregate and cement for the construction of a large reinforced concrete factory. Advantage of the location was taken to secure an ingenious arrangement that provided for the very convenient and rapid unloading of materials and for handling them largely by gravity in a manner that greatly expedited the work and reduced the cost of mixing about 25,000 yards of concrete.

The aggregate bin 21 feet wide, 9 feet deep and 84 feet long, was built with a horizontal bottom about 9 feet above the canal bed and the top at street and track level, permitting trucks in which the sand was delivered from a local supply, and the cars in which the broken stone and cement were delivered, to be run over the tops of the bins where two longitudinal standard gage, full length tracks were installed and a slightly inclined ramp transverse to them for the sand tucks which thus delivered directly to the sand compartments occupying the center portion of the bins, the ends of which were used for stone storage. Stone is dumped from the cars into the open tops of the bins and sand is dumped from the trucks in through an iron grating covering the top of the sand bin.

Between the tracks on top of the bin there is installed, 6¾ feet above them at a convenient height for handling the cement bags from the car floors, a gravity conveyor, parallel to the tracks, that runs through the cement storage house and terminates on the charging platform over the concrete mixer, thus providing for the unloading, storage and direct delivery of cement.

Cement and sand are discharged by gravity through four 12 x 15-inch gates in the horizontal bottom of each bin, which are arranged in pairs so that both sand and stone gates can be operated simultaneously. The sand and stone are delivered into a measuring hopper, with two compartments giving the required amounts for one batch, that is moved from end to end of the bins on a track underneath them by means of an electric hoisting engine and cable.

The measuring hopper delivers into a charging car running on a parallel track beneath it, on the bend of the canal, which is hauled back and forth and up an incline by an electric hoist. It discharges into the charging hopper of the concrete mixer which is also served by a chute delivering cement from the platform above.

Concrete is mixed in two four-bag Ransome machines that discharge into chutes delivering from opposite sides into ordinary V-shape dump cars on an industrial track on the canal bed.

Four-car trains of concrete are hauled by a gasoline locomotive on a service track running to the three hoisting towers, one in the middle and one at each end of the building. Each train delivers two cars to each of two towers, while another train is being loaded and the locomotive is then switched across to the back track and brings back the empties, returning again for the next trip with full cars and so on. From the hoisting towers the concrete was spouted directly to the foundation piers and heavy retaining walls and to nearby portions of the superstructure, the more distant parts of the latter being served with concrete buggies operating from distributing hoppers on each floor.

Road Construction in Chatham County, Georgia

Three large contracts are now under construction, each for a concrete road. All three contractors use the same make of mixer and two use mechanical loaders. Two also use mechanical finishers. One hauls by mule teams, one by trucks and one by gasoline engine on construction track. The county and city are building a memorial road by day labor.

One of the first counties in the Southern States to start its 1920 road work was Chatham County, Ga., of which Savannah is the county seat and only large city. This county at present has under construction three contracts, one on each of the highways known as the Fort Wentworth road, the Ogeechee road and the Lewisville road, which are to be paved with concrete laid on the old shell or gravel surface. In addition, there is soon to be let a contract for the Tybee road, which will total 16 miles with 2800 lineal feet of bridges, which include three draw-spans, the estimated cost of this improvement being about $900,000.

The three roads now under contract lead from Savannah to the county line. The entire country is very flat and quite low, but the drainage of these roads had already been provided for during the earlier construction and improvement work. The Tybee road will lead from Savannah through the low lands and islands between that city and the ocean.

The Port Wentworth road is 15 miles long, eight miles to be paved 20 feet wide and the remainder 16 feet. The cost will be about $570,000. The Ogeechee road is about 12½ miles long and will be paved 16 feet wide. The plans provide for three concrete bridges of 60 foot, 70 foot and 80 foot span, respectively. The estimated cost is $450,000 The Lewisville road improvement is about 13 miles long, about 3¼ of it being built by Federal aid and 18 feet wide and the remainder, to be built entirely by the county, is 16 feet wide. The former is estimated to cost $111,736 and the latter $410,308. There are no bridges on this road.

Each of the roads is being surfaced with 1-2-3 concrete uniformly 6 inches thick, the sub-grade being given the same crown as that required for the surface; except that the 20-foot section of road is 8 inches thick. Granite is used for the coarse aggregate, being the only material available. In each case, the old road which is used as the subgrade is shaped up and rolled solidly immediately

LOADING CONCRETE MIXER ON CHATHAM COUNTY WORK.
The mixer is shown at the left. At the right is seen the loader, consisting of a belt conveyor carried on a trussed car.

in advance of the concrete construction. Expansion joints are placed 50 feet apart, "Elastite" being used in these joints.

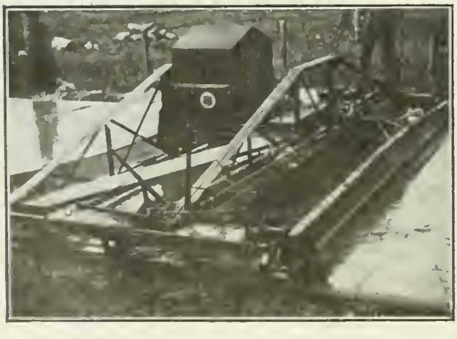
CONSTRUCTION METHODS.

The pavements being laid on these roads are similar in all respects, except for the differences above noted, and there is also considerable similarity in the methods and appliances used by the several contractors. The Port Wentworth road is being constructed by the Dixon Construction Company; the Ogeechee road by W. T. Hadlow of Jacksonville, and the Lewisville road by the Lawrence Construction Company of Augusta.

Each of these contractors uses a Koehring concrete mixer, and two use a Koehring loader instead of wheelbarrows for bringing the aggregates to the mixer. Also, each of the contractors brings his aggregate to the nearest point by cars and unloads it from the cars by means of a crane.

For transporting the aggregate from the railroad siding to the work, however, each employs a different method. For the Port Wentworth road, the Dixon Construction Company uses wagons hauled by mules, the maximum length of haul being four miles, there being a number of sidings available a comparatively short distance from the road. The contractor for the Ogeechee road uses an industrial railroad with two-foot gauge. The cars are hauled by a gasoline engine, the aggregate being carried by them in batch boxes which are filled by the crane at the siding, each box holding measured aggregate sufficient for one batch, and being dumped into the skip of the concrete mixer directly from the cars. The maximum haul on this contract is 6 miles. The equipment used on this work by this contractor is said to have cost about $75,000. The Lawrence Construction Company does its hauling by trucks, using a number of these, mostly of the Garford and 4-Wheel Drive Auto Company make.

For finishing the concrete surface, the Dixon Construction Company uses a hand roller followed by a length of garden hose dragged over the surface, which is said by the county engineer to give an excellent finish, better than the use of a belt. W. T. Hadlow and the Lawrence Construction Company used Lakewood finishers; also Blaw-Knox forms for the concrete, the finishing machine running upon these as a track.



FINISHING CONCRETE PAVEMENT BY MACHINERY.

After completion, each of the roads is protected from the sun by canvas supported on a frame until the surface has hardened, when it is covered with 1½ inches of dirt which is kept wet. Eighteen days after completion the dirt is removed and the pavement thrown open to traffic. The contractors have to obtain water for mixing concrete and moistening the earth by sinking wells, except at occasional points where they can obtain it from public water supplies. These wells are sunk 500 or 600 feet deep, ordinarily about 4 miles apart so that water can be provided to all parts of the work by pumping through a length of pipe not exceeding two miles. Two-inch pipe is ordinarily used for carrying the water from the well to the work, T's being inserted in this at intervals to permit hose connections.

Payment for the concrete work is made by the square yard, including the concrete surface only. The two last contracts let went for $2.68 and $2.84 respectively, but so far as known no contract has been let in the State of Georgia this spring at less than $3, and the prices are rising considerably above this. The preparation of the old road, which is done by scarifying, shaping up and rolling, is paid for additionally by the square yard

MEMORIAL ROAD.

In addition to the roads mentioned, the county is constructing by day labor a memorial road, to be dedicated to the memory of the men of the county who fell in the World War. The county is completing about two miles of this road and 1,800 feet additional is being constructed by the city, this being an extension for this distance within the city limits. This road consists of two drive-ways with a parkway between them, which parkway will be sodded and contain two rows of palmettoes. Near the mid-length of the road will be a circle, in the center of which will be erected a monument of stone carrying bronze tablets. The construction of the road will be paid for by county and city funds, but the monument is to be paid for by money raised by popular subscription, nothing more than $5 being accepted from any one person. The cost of the monument will be about $20,000. The county bond issue contains $105,000 to be used for this road. At present the county work on the road consists of filling in across a low spot several hundred feet wide and light grading on the balance of the road. For this purpose the county is using, as a construction railway, an old street railway track which was purchased by the county in order to remove the railway from the memorial highway, one rail of the track being moved in so as to narrow it to the gauge of the construction engine and cars. A part of the force used in this construction is convicts.

In this connection, we were informed that the county highway and drainage work was suffering considerably from the lack of convicts to be used as laborers. Prior to last July they could always count on 500 or 600 convicts available for this use, but the supply has now fallen to 100 to 125, including women. Owing to the fact that most of the convicts are negroes, and that free negroes cannot be relied upon to work many days in succession, while convicts can be kept at the work six days a week, the county authorities consider one convict to be the equivalent to two free negroes, if not more.

For the above information and for courtesies shown in a visit in this work, the writer is indebted to W. F. Brown, county engineer, to Judge Oliver T. Bacon, chairman of the County Commissioners, and to G. Reuben Butler, clerk of the Commission.

Repairing Docks in Mexico

U. S. Commercial Attaché Edward F. Feely reports from Mexico City that the ministry of communications and public works is making a study of the needs of docks, piers and similar structures in various ports of the Republic, some of which, notably at Salina Cruz and in ports of Lower California, are in defective condition. It is proposed to obtain an appropriation of 400,000 pesos for the work, and Salina Cruz will be the first port to receive attention.

The Paving Problem in Japan

By Prof. T. Takakuwa *

Japanese streets, until recently used only for light, slow traffic, are mostly dirt roads, with a small amount of gravel surface. Increasing commerce and industry and advent of numerous automobiles necessitate much immediate paving. Bituminous and concrete surfaces have very promising future and require heavy importations.

I may say that at present we have almost no paved roads at all in Japan. Even the city of Tokio, the capital of Japan, has only a few miles of paved streets and this circumstance is due only to an experiment which was made several years ago. The cities of Osaka and Kobe are in the same condition.

FEW GRAVEL ROADS AND UNIVERSAL MUD.

All of the highways in Japan, the streets and country roads, generally, consist of poorly constructed gravel roads, this gravel being easily obtained from the many rivers running through the country. Thus it is quite clear that such roads get very dusty in dry weather and very muddy in wet weather

In January of last year, *Good Roads* explained fully the present Japanese roads in describing the visit of Samuel Hill, former president of The American Road Builders' Association, to Japan. The description reads as follows: "Japan figuratively speaking, lies within the realm of King mud. For nine months of the year the roads are endless lines of seemingly bottomless ooze. Only in the seaport cities, pavements are to be found. Everywhere else is mud and mud."

I am sorry to say that we must unwillingly recognize this candid description as a fact, in part. These bad roads throughout the country are the constant cause of innumerable disadvantages and supreme discomfort to our people and also are a constant wonder and annoyance to the foreigner who visits Japan.

EXPLANATION OF ROAD CONDITIONS.

What is the reason for such a condition being permitted to exist in Japan even up to the present time? There are three principal reasons which I may mention and which are as follows:

Firstly, I think it might be said without the slightest hesitation that the unconsciousness and indifference of our nation as to the benefits and advantages of establishing good roads, comprise one of the principal reasons of the present road conditions.

The second reason consists in the fact that all municipal improvements in Japan are far behind those of the Occidental world, that is, around two or three decades. Therefore, not only the road system, but many other municipal improvements necessary in Japan, are still in their embryo.

The third reason, though of minor importance, is that: Light and slow-speed vehicles constitute most of the traffic in Japan, the principal means of transportation on the road being the one-horse carriage which carries about a one-ton load and the light carriage drawn by men. We have very seldom such heavy traffic as to necessitate the use of two or more horses, as in this country, moreover, automobiles have been very little in use until quite recently. So, in spite of the inferiority of our roads, they have been able to bear up under the lighter traffic of the past.

IMPORTANT DEVELOPMENTS IN PROGRESS.

But during the past few years, in consequence of the speedy development of business industrially and commercially, the amount of traffic has constantly been on the increase. Especially, the great number of motor vehicles and heavy motor trucks which are being imported into Japan every year, are constantly increasing. Moreover, in consequence of the increase of the labor cost, development of industries and trades, and the great expansion of our principal cities since the late war, there is, in Japan an ever increasing demand for heavier vehicles and motor trucks of various kinds. In my opinion, we shall in no distant future have more than 100,000 motor cars in Japan.

Such traffic increases will prove destructive in the extreme to our poor road system and ever since a few years back, they have, more or less, converted the city roads into a state of muddy ooze and dusty deserts. Thus, it is quite evident that our people are subjected to extreme annoyance on account of the poor condition of the road and the terrible dust caused by traffic in general. As a result, therefore, their own personal experience of discomfort has roused them to action and hence the improvements of our streets and the paving of the highways in Japan has become an exceedingly great problem to the public, generally.

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*Of the Kiriu Technical College of Japan.

NEW CITY PAVEMENTS PROPOSED.

After much discussion by municipal authorities, the city of Tokio and Osaka decided to lay down perfectly new pavements throughout the said cities, provided the central government granted the necessary subsidy, that is, one third of the amount required for the construction of the roads. Should the subsidy be granted, the work will commence this spring. Other big cities, as, for example, Kobe, Kioto and Yokohama are also in the process of deciding this all important question. Thus, as may be seen, the paving enterprise is growing rapidly and will develop into a big business in the near future in Japan.

TOKIO'S PROGRAM.

Tokio city proper has 600 miles of public road which covers an area of approximately 10,000,000 square yards, corresponding to nearly 11 per cent of the total area of the city, viz., 30 square miles. The plan which was recently decided upon by the municipal authorities of Tokio is as follows: Firstly, to pave within the next eight years, commencing from this spring, the principal main streets running through the city which have a width of 36 feet or more. This represents 167 miles of street and the actual area to be paved covers 4,400,000 square yards. After the completion of this plan it is suggested that all the remaining streets be paved at the earliest opportunity.

But, it seems that this plan offers no speedy relief, seeing that at the above rate it would take more than fifteen years to complete all the pavements of the city. Aside from this, we must bear in mind that the city of Tokio, besides the city proper, above mentioned, has an environment which covers an extensive and constantly increasing area representing twice that of the city proper, and will, in the near future, be annexed to greater Tokio. Considering the facts just mentioned it is my belief that it will in the near future, be possible to make up a plan along more speedy and progressive lines.

OSAKA'S PROGRAM.

The city of Osaka, which is the largest business and industrial city next to Tokio and has about 350 miles of public roads, estimating approximately 6,700,000 square yards, has lately decided also on a plan of improving the streets and the plan suggested appears in all instances to be a more progressive one than that contemplated by the city of Tokio. This plan is to lay down whole streets of the city with new pavement within the next ten years.

WOOD BLOCK AND BITUMINOUS PAVEMENTS PREFERRED.

The question as to what kinds of pavement would be most favorable to these cities, offers a most interesting and important feature for investigation. The municipal authorities of Tokio and Osaka contemplated adopting the plan of constructing bituminous pavements and wood block pavements throughout the greater part of the city. However, on account of the constant increase in the price of wood, which apparently will increase still more in the future, even more so than other articles, it will of a necessity follow that the laying out of wood block pavements will be limited to a certain extent. As a consequence, then, bituminous pavements, i. e., sheet asphalt and bituminous concrete pavements will more and more come into general use in these cities of Japan.

Bituminous paving materials, both of the mineral aggregates and the bituminous substances, are produced in Japan to some extent but the latter is not sufficient in quantity for the ever-increasing future demands and besides it is, at present, not fully satisfactory in quality. Hence the importation of such bituminous substances from other countries would be necessary to some degree. Moreover, Japan is ill-equipped with machinery for road construction and it would be of the utmost importance to bring about the importation of suitable machinery, as well.

GOOD FUTURE FOR CONCRETE PAVEMENTS.

At present Japan has no paving-brick factories whatsoever, and it is also a matter of doubt whether or not the future will see this industry established in Japan. The matter has never been given a thorough research, although other brick and clay industries are carrying on flourishing trade in Japan. We have many portland cement factories in Japan which produce good cement for road paving purposes, and even export to foreign countries. Hence the cement concrete pavement has quite a great future before it in Japan.

Solidifying Embankments

The settlement of newly-laid earth embankments for highways is accelerated and a permanent condition reached that prevent a large amount of cracking of the concrete surface by the application of the ponding method. This simply consists of building a clay dam or dyke 12 inches high at both sides of the road with occasional transverse dams of the same height about 10 feet apart and keeping the enclosed area saturated with water penetrating to the bottom through full depth post holes afterwards backfilled. Usually sufficient saturation is secured by filling nearly to the top of the dams two or three times.

A big sewer cleaning job was recently done at Dubuque, Ia., where 3,800 yards of material were taken from 3,100 linear feet of sewers, 9 feet wide and 7 feet high, that were filled to a depth of 4 feet with mud and dirt and rubbish, including 400 loads of macadam that will be used for city road work this spring. The obstructions were so serious that they had caused the sewers to overflow and produced destructive floods in the streets.

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The National Highway Bill

As congressional action becomes more imminent on the Townsend Bill to create a new Federal department to administer the highway affairs of the United States, it may be well to again define some of its principal features for the purpose of reassuring those who may still be in doubt of the beneficial results of such legislation, especially those who are inclined to oppose it on the ground that the Act proposes to take over all highway work as a Federal function, thus interfering with present state highway departments and jeopardizing Federal aid for state improvements.

Quite the reverse is true in that, far from superseding the Federal aid plan, the highway act seeks to extend that plan and assist the different states in their local improvements by relieving them of the construction and maintenance of the routes that may be designated as portions of the National system. The roads so designated will, however, it is estimated, amount to only about 1 per cent of the total mileage in each state, a proportion that certainly could not dominate the rest

The unassailable system of the Act is to provide for the harmonious design, construction and maintenance of Interstate lines so that the different elements will be co-ordinated and secure the greatest efficiency and the shortest and best routes for through traffic, interlocking all portions of the system and making all sections equally available, uniform and continuous.

Such a system has the advantages that it should serve as a model and an incentive for local highway construction, that it will afford superior outlet for the increasing traffic originated on local roads, that it will eliminate a great deal of waste, delay and duplication, and especially that it will rapidly provide almost unlimited facilities for motor trucking that, in the not impossible contingency of railroad strikes, will insure a degree of flexible and independent transportation by motor trucks with private, corporate and municipal operation would greatly relieve the paralysis of commerce, congestion of freight, and scarcity of food that would be otherwise inevitable.

Another most important consideration, and one that could hardly be provided for by independent state action, is the planning of Federal roads so as to give a network of communication between military points that would be invaluable in case of invasion, industrial trouble or any other disorders that require mobilization of men, or supplies, or ordnance. It was the possession of such a system of well located, designed and constructed roads that gave Germany an opportunity to commence a war with an impetus that carried beyond the zone of her own road systems, and required such a vast expenditure of life and treasure to subdue. Such systems on our long unfortified sea coast and on our Mexican border are obviously necessary and would vastly reduce the cost and delay and correspondingly increase the efficiency of any adequate system of defense.

Municipal Sand and Gravel Plants

There are very few cities, towns, or villages but that require large quantities of sand and gravel for concrete for public works and all of them, as well as counties, require it for road building. In very many cases it is purchased at a disadvantage often with uncertain delivery and at high prices when it might as well, or better, be provided by the municipality.

There are two principal sources, one or the other of which is almost always available, namely, excavations for the work under construction or at nearby points that may provide either sand or gravel or both with or without washing and screening; and the opening of banks or pits for a permanent supply. The latter is likely to involve longer hauls but has the advantage of usually affording a larger and better supply.

In either case, materials can be excavated, stored and delivered with a simple equipment and common labor at a cost which there is no good reason should be greater than that of the ordinary producer or dealer, thus securing independence and economy. The establishment of such a plant or plants involves only a very moderate investment of standard equipment, which can easily be bought and sold in open market and will afford employment for a regular crew that should pay dividends on their cost, as well as giving an opportunity for employment of regular forces when they cannot be used for their usual work, thus keeping up the organization and benefitting the men.

Sand and gravel production can be carried on throughout the winter when most forms of construction are impeded and supplies can be provided in advance for hurried work.

A source of supply that often yields the best quality of material is frequently overlooked in the deposits in the beds of creeks, rivers and ponds, the location of which has the additional advantage of insuring abundance of water for washing and for facilitating handling. Some hints of a simple method of operations may be found from the article on page 290, and any competent engineer or superintendent can modify the system there described or perhaps can see advantages in an entirely different system such, for instance, as dredging material with pumps where a large output is required.

Politics Eliminated from Road Building

A principle that is vital to all public construction was emphasized recently by Wm. C. Sproul, governor of Pennsylvania, who, in an address to 300 engineers, assistant engineers and inspectors of the State Highway Department in annual convention at Harrisburg, assured them that the "intervention of politics will not hurt any state highway department employe who tries to do his duty."

The Governor defined the state highway department as a non-political organization which is planned to be a very large and businesslike department especially intended to serve as a model for other state departments in Pennsylvania and throughout the country, and assured his hearers that loyalty and efficiency on their part would insure promotion.

Such a policy extended through the 800 miles of new construction planned for Pennsylvania during 1920 is worthy of the progressive spirit that has undertaken the improvement and, if well observed, cannot fail to bring immediate reward in the excellence and economy of the work, besides which it will strengthen the foundations for better working conditions that are so much needed throughout the country, especially at this time when we are recovering from the war emergency and the relaxation and temporary arrangements necessitated, or believed to be justified by the emergency.

There is no sufficient reason why public works should not be carried on with the efficiency, rapidity and economy that are attained by private enterprises if only all considerations were governed by intrinsic merit, efficiency, honesty, and economy, which would enable the great public resources to secure even better results than can be obtained by limited private enterprise. If there is no political pressure allowed to interfere with the reward of efficiency or the removal of inefficiency, and if the zeal of making the work profitable can be made as great as is commanded by self-interest in private enterprises and the public be no longer looked upon as a boundless reservoir from which to draw unlimited amounts to cover mistakes, graft, and extravagance, road building and other kinds of public work will rise to great success and in the end even the political reward will be greater than ever because such results from any administration will be its highest testimonial and one of great worth with the people.

County Highway Data

Responding to requests of PUBLIC WORKS, county engineers and other county officials representing between three hundred and four hundred counties of the various states have furnished, during the past month, answers to a questionnaire, which we have tabulated and present in this issue. Other tabulations will be presented in later issues.

Hundreds of millions were spent on road work last year, in spite of the various adverse conditions and delay in getting started after the war. Part of this was spent by states, part by counties, by townships or other units. In most of the states a large part of the expenditure was made by the counties, although in a few the counties as such do no road work, as in Vermont. In almost every state, however, federal, state, county and township funds were combined in different proportions in carrying out the road program.

To learn how much was spent in a number of typical counties last year, and in what way, we have secured, through the courtesy of county officials, a considerable amount of data concerning about four hundred counties scattered throughout the several states. Most of these have been tabulated and are given in following pages. Others, which we have had neither time for tabulation nor space for publishing in this issue, will be published in later issues.

The data given in the first table were furnished in reply to the following questions:

"How much money, including county, state and federal appropriations, was spent during 1919 for highway work in your county?"

"What kinds of road surface were constructed, and what amount of each?"

"How much of the above was done by county or state forces?"

"How much was done by contract."

The second table contains the answers to the following questions:

"What width of shoulders do you use with each type of road?"

"What surface material is laid on or other treatment given to the shoulders?"

"How do you protect (by curb or otherwise) the outer edge of your pavements?"

The third table contains information derived from replies to the questions:

"What kinds of pavement did you resurface last year?"

"What kinds of material were used for resurfacing each of these?"

"How long had the old pavements on the several roads been in service?"

"What was done to the old surface before adding the new material?"

"What was the cost of each class of resurfacing, per square yard or mile?"

"In what way, if any, did you use the materials removed from the old pavements?"

Data were obtained concerning maintenance of several kinds of road surface, but only water-bound macadam is given this week; the others will appear in later issues. Informants were requested to state whether the costs given included anything besides labor and material; also to state approximately the average number of vehicles per day, their average weight, etc.

COUNTY HIGHWAY WORK DONE DURING 1919.

State and County	Amount of county, state and federal money spent.	Bitu-minous concr. miles or sq. yds.	Bitu-minous macadam miles or sq. yds.	Plain macadam miles or sq. yds.	Sand-clay miles or sq. yds.	Gravel miles or sq. yds.	Cement concrete miles or sq. yds.	Brick miles or sq. yds.	Earth miles or sq. yds.	Other work.	Done by county or state forces	Done by contract.
Alabama:												
Calhoun	$9,900	......	12	......	......	......	......	......	......	Chert, 15	None	All
Etowah	55,000	......	4½	......	......	......	......	......	10	......	75 per cent.	25 per cent.
Monroe	12,000	......	......	......	......	4½	......	......	......	......	All	None
Arkansas:												
Jefferson	300,000	......	20	......	......	15	......	......	......	......	10 per cent.	90 per cent.
Miller	150,000	......	......	......	......	69	......	......	......	......	None	All
Scott	20,000	......	......	......	......	......	......	......	......	Grading only	All	None
Sevier	400,000	......	......	......	......	60 8"x14'	......	......	......	......	None	All
Several (not named)	100,000	......	......	......	......	14½	......	......	......	......	None	All
California:												
Plumas	55,000	......	......	......	......	......	......	......	All	......	All	Nono
Solano	200,000	......	......	......	......	......	3	......	......	Repairs & bridges	......	......
Connecticut:												
Fairfield	20,000	......	......	0.75	......	......	......	......	......	......	All	None
Delaware:												
Sussex	......	......	......	......	......	......	......	......	......	All by state	None	All
Florida:												
Bay	300,000	......	......	......	15	......	......	......	100	......	None	All
Brevard	120,000	......	......	......	......	......	......	......	......	Shell	All	None
Dade	175,000	......	......	25	......	......	......	......	......	Coral rock, 25	All	None
Hillsborough	350,000	......	......	......	......	......	......	......	......	Asphalt block on shell base, 10; shell, 15	Shell	Asphalt block
Levy	100,000	......	......	......	20	......	......	......	......	Coral rock, 10	20	10
Pasco	50,000	......	......	6	......	......	......	......	......	......	None	All
Sumter	14,000	......	......	......	Some	......	......	......	......	Maintenance	All	None
Idaho:												
Bonneville	3,500	......	......	......	......	......	......	......	......	Surveys	......	......
Jerome	75,000	......	......	......	......	......	......	......	......	Grading & culverts, 15	All	None
Payette	10,000	......	......	......	......	3	......	......	......	......	All	None
Illinois:												
Carroll	64,000	......	......	4	......	3	0.5	......	......	Grading, 20; oiling, 8	None	All
Christian	170,000	......	......	......	......	......	......	......	9	Oiling, 64	9	21
Dewitt	100,000	......	......	......	......	......	......	......	40	......	35	5
Douglas	153,000	......	......	2.5	......	......	2.1	3.5	......	......	None	All
Fulton	180,000	......	......	......	......	......	2.5	......	......	Oiling, 15	Oiling	Concrete
Hamilton	30,000	......	......	......	......	......	......	......	300	......	$27,000	$3,000
Iroquois	650,000	......	......	......	......	......	20	......	......	......	Very little	Almost all
Kane	420,000	......	......	......	......	......	2	......	......	......	None	All
Knox	120,000	......	......	......	......	......	......	......	All	Some oiled	All	None
Lake	175,000	......	......	......	......	......	5.5	......	......	......	None	All
Lawrence	90,000	......	......	......	......	18	......	......	......	......	None	All
Logan	98,974	......	......	......	......	20	......	......	......	......	None	All
McDonough	100,000	......	......	......	......	......	......	......	......	Oiling, 70	All	None
Macoupin	65,000	......	......	......	......	......	2.5	......	......	......	None	All
Madison	350,000	......	......	Repair 2.5	......	......	6.5	3.6	......	......	2	10.6
Monroe	39,000	......	......	......	......	......	......	......	......	Grading, 500	All	None
Ogle	285,000	......	......	......	......	......	6.5	......	Some	......	None	All
Pike	36,000	......	......	......	......	7	......	......	......	......	All	None
Schuyler	100,000	......	......	......	......	......	1.5	......	Some	......	Earth	Concrete
Wabash	20,000	......	......	......	......	6	......	......	......	......	None	All
Warren	44,000	......	......	......	......	1	0.75	......	......	......	None	All
Indiana:												
Adams	74,444	......	......	Repair 15	......	......	......	......	......	......	None	All
Delaware	28,690	......	......	2	......	2	......	......	......	......	Maintenance	New construction
DeKalb	68,500	......	2.5	2	......	4	2	......	......	......	None	All
Franklin	50,000	......	......	3	......	4	......	......	......	......	None	All
Fulton	98,000	......	......	......	......	12	......	......	2	......	None	All
Hancock	200,000	......	......	10	......	25	3.5	......	......	......	None	All
Howard	110,000	1.5	......	2	......	4	2	......	......	......	None	All
Jennings	28,000	......	......	2.4	......	......	......	......	......	......	None	All
Posey	50,000	......	......	......	......	6	......	......	......	......	None	All
Shelby	......	......	......	......	......	11.5	1.5	......	......	......	None	All
Tippecanoe	240,200	......	......	......	......	20	......	6	......	......	None	All
Vigo	......	......	......	......	......	10,000	24,000	30,500	......	Asphalt, $72,000	None	All

COUNTY HIGHWAY WORK DONE DURING 1919 (Continued).

State and County	Amount of county, state and federal money spent.	Bitu-minous concr. miles or sq. yds.	Bitu-minous macadam miles or sq. yds.	Plain macadam miles or sq. yds.	Sand-clay miles or sq. yds.	Gravel miles or sq. yds.	Cement concrete miles or sq. yds.	Brick miles or sq. yds.	Earth miles or sq. yds.	Other work.	Done by county or state forces.	Done by contract
Iowa												
Bremer	103,000	......	......	......	......	2	......	......	6	......	All	Bridges
Buena Vista	88,237	......	......	......	......	39	......	......	......	......	None	All
Cerro Gordo	153,000	......	......	......	......	......	2	......	......	......	None	All
Clarke	60,000	......	......	......	......	......	......	......	Maint.	......	All	None
Clay	33,194	......	......	......	......	10	......	......	......	......	4	6
Clinton	166,166	......	......	......	......	1	......	......	......	Grading, 14	None	All
Davis	72,000	......	......	......	......	......	......	......	......	Grading, $20,500; bridges, $61,600	All	None
Decatur	39,500	......	......	......	......	......	......	......	165	......	All	None
Dickinson	20,000	......	......	......	......	maintenance	......	......	......	......	All	None
Emmet	106,665	......	......	......	......	38.6	......	......	15	......	None	All
Fayette	120,000	......	......	......	......	......	......	......	10	......	All	None
Greene	111,173	......	......	......	......	4.82	......	......	......	......	2	2.82
Grundy	40,000	......	......	......	......	......	......	......	......	......	......	$15,000
Hamilton	197,000	......	......	......	......	34	......	......	......	Bridges, $78,000	None	All
Harrison	38,600	......	......	......	......	......	......	......	21.5	......	All	None
Humboldt	88,600	......	......	0.5	......	12	......	......	......	......	Macadam	Gravel
Ida	136,646	......	......	......	......	......	......	......	Maintenance	Bridges & culverts, $97,682	All roads	Bridge, $18,500
Iowa	195,839	......	......	......	......	......	......	......	......	......	......	......
Jasper	77,000	......	......	......	......	$7,000	......	......	......	......	......	$20,000
Johnson	150,000	......	......	......	......	......	......	......	All	......	All	None
Keokuk	30,741	......	......	......	......	......	......	......	......	Grading & draining	None	All
Kossuth	67,000	......	......	......	......	2.5	......	......	22	......	None	All
Lucas	115,056	......	......	......	......	......	......	......	All	......	$97,055	$18,000
Lyon	80,000	......	......	......	......	8	......	......	......	......	$43,000	$37,000
Mills	110,000	......	......	......	......	......	......	......	......	Grading	$70,000	$40,000
Mitchell	119,500	......	......	......	......	2	......	......	......	Grading & draining	All	None
Monroe	64,774	......	......	......	......	......	......	......	......	Grading, 3	None	All
Montgomery	263,000	......	......	......	......	......	......	......	All	......	All	None
Muscatine	79,576	......	......	......	3.06	......	......	......	......	......	None	All
O'Brien	100,000	......	......	......	......	......	......	......	All	......	None	All
Palo Alto	40,206	......	......	......	......	......	......	......	......	Grading, draining, purchasing gravel pits	......	......
Plymouth	39,932	......	......	......	......	......	......	......	......	Grading, 12	All	None
Ringgold	127,077	......	......	......	......	......	......	......	$30,304	Bridges & culverts, $96,773	Earth, $26,304	The rest
Sac	86,360	......	......	......	......	1.25	......	......	......	......	$70,000	Bridges, $16,350
Scott	......	......	......	2.6	......	......	......	......	8	......	None	All
Shelby	28,799	......	......	......	......	......	......	......	All	......	All	None
Story	126,000	......	......	......	......	27	......	......	......	......	None	All
Union	48,000	......	......	......	......	......	......	......	All	......	......	$15,000
Van Buren	40,000	......	......	......	......	......	......	......	All	......	All	None
Kentucky												
Bell	20,000	......	......	6	......	......	......	......	......	Grading, 2	None	All
Boone	87,600	......	......	All	......	......	......	......	......	......	$35,137	$62,476
Henderson	153,300	......	......	......	......	6	......	......	......	......	4	2
Owen	60,000	......	......	11	......	......	......	......	......		9	2
Rockcastle	81,190	......	......	2	......	1	......	......	8.5	......	All but	6.5 earth
Whitley	42,000	......	......	......	......	......	......	......	......	Grading, drainage, bridges	$27,000	$15,000
Louisiana												
Avoyelles	30,000	......	......	......	......	All	......	......	......	......	None	All
Richland	40,000	......	......	......	......	9.6*	......	......	......	......	None	All
Maine												
Penobscot	52,164	......	......	......	.	6.04	......	......	......	......	All	None
Michigan												
Alger	138,000	......	......	5	......	......	......	......	6	......	50%	50%
Cass	200,000	......	......	......	......	30	7	......	......	......	28	9
Eaton	113,327	......	......	......	......	16.5	......	......	......	......	7.6	8
Gogebic	160,000	......	1.5	......	......	......	......	......	......	Grading, 10	None	All
Luce	66,000	......	......	......	......	4	......	......	......	......	All	None
Macomb	1,000,000	26.62	3.60	......	......	21.67	8.875	......	......	......	None	All
Marquette	148,000	......	......	5	......	6.5	......	......	......	Grading, 8	Macadam	All other

Mecosta	......	......	......	......	......	7	......	......	......	......	None	All
Muskegon	88,000	......	......	......	......	......	......	......	......	Maintenance	All	None
Schoolcraft	125,000	......	2.5	1.5	......	1.0	......	......	......	......	All other	Bit. macadam
Minnesota												
Aitkin	30,000	......	......	......	......	6	......	......	......	......	2	4
Big Stone	97,000	......	......	......	......	5	......	......	......	Grading, 28	None	All
Brown	99,227	......	......	......	......	21	......	......	......	Grading, 16	Gravel & 5 mi. of grading	All other
Carlton	117,000	......	......	......	......	5	......	......	......	Grading, 20	3 mi. of gravel	All other
Chippewa	131,837	......	......	......	......	6	......	......	15	Maintenance	Maintenance	$80,720
Chisago	145,000	......	......	......	......	40†	......	......	......	......	None	All
Crow Wing	150,000	......	......	......	......	6.5	......	......	......	Grading, 14	4¼ of gravel	All other
Dakota	......	38,653	......	......	......	3.0	......	......	......	......	......	......
Dodge	105,000	......	......	......	......	5	......	......	14	......	2	17
Goodhue	234,556	......	......	......	......	13	2	......	25	......	4 of gravel	All other
Grant	45,000	......	......	......	......	7	......	......	7	......	None	All
Itasca	150,000	......	......	......	......	4	......	......	9	......	None	All
Jackson	102,000	......	......	......	......	......	......	......	......	Grading & 5 mi. oiling	All	None
Kanabec	40,000	......	......	......	......	All	......	......	......	......	All	None
Kandiyohi	205,000	......	......	......	......	9	1.5	......	......	Grading, 15	All but	Concrete
Lyon	200,600	......	......	......	......	19	......	......	......	Grading, 16	None	All
Marshall	92,140	......	......	......	......	20	......	......	......	Grading, 38	None	All
Nicollet	49,384	......	......	......	......	3	......	......	......	Maintenance & equipment	None	All
Sibley	62,000	......	......	......	......	16	......	......	......	......	1.75	14.75
Stearns	125,000	......	......	......	......	12	......	......	......	......	$65,000	$60,000
Steele	58,604	......	......	......	......	9.5	......	......	9.5	......	None	All
Stevens	66,815	......	......	......	......	......	1.1	......	......	......	None	All
Wadena	20,877	......	......	......	1	......	......	......	......	Maintenance	All	None§
Waseca	90,000	......	......	......	......	11	......	......	8	......	All	None
Watonwan	80,000	......	......	......	......	......	......	......	20	......	None	All
Missouri												
Callaway	51,000	......	......	......	......	......	......	......	12	Maintenance, $19,000	All	None
Camden	20,000	......	......	......	......	......	......	......	75	......	All	None
Carter	40,000	......	......	......	......	......	......	......	28	......	All	None
Clark	13,000	......	......	......	......	......	......	......	All	......	All	None
Cooper	75,000	......	......	......	......	......	......	......	All	......	None	All
Harrison	......	......	......	......	......	......	......	......	All	......	......	......
Jefferson	20,000	......	......	Part	......	Part	......	......	......	......	All	None
Lincoln	37,753	......	......	......	......	8	......	......	35	......	All	None
Mississippi	20,000	......	......	......	......	......	......	......	......	Grading & maintenance	......	......
Monroe	32,000	......	......	......	......	......	......	......	Maintenance	Grading, culverts, &c.	All	None
Morgan	30,100	......	......	......	......	Part	......	......	Part	......	All	None
Ozark	20,000	......	......	......	......	......	......	......	......	Maintenance	All	None
Pearl River	45,000	......	......	......	......	......	......	......	All	......	All	None
Phelps	40,000	......	......	......	......	10	......	......	20	......	All	None
Polk	20,000	......	......	......	......	......	......	......	50	......	All	None
St. Clair	31,248	......	......	......	......	......	......	......	......	Grading	......	......
Washington	43,000	......	......	......	......	10	......	......	......	Grading, 30	All	None
Yazoo	......	......	......	......	......	All	......	......	......	......	None	All
Montana												
Beaverhead	61,500	......	......	......	......	2	......	......	50	......	All	None
Carbon	190,000	......	......	......	......	6	......	......	120	......	$150,000	$40,000
Cascade	350,000	......	......	......	......	5	......	......	100	Cinder, 6	$212,000	$138,000
Chouteau	118,945	......	......	......	......	......	......	......	All	......	$111,000	$8,000
Gallatin	175,680	......	......	5	......	......	......	......	20	......	$109,634	$66,047
Granite	20,000	......	......	......	......	1	......	......	......	Maintenance	All	None
Hill	50,000	......	......	......	......	......	......	......	All	......	All	None
Madison	71,380	......	......	......	......	......	......	......	Maintenance	......	All	None
Musselshell	246,814	......	......	......	......	......	......	......	All	......	......	33%
Sanders	48,000	......	......	......	......	3	......	......	......	......	All	None
Stillwater	35,000	......	......	......	......	......	......	......	......	Maintenance	All	None
Valley	75,000	......	......	......	......	1⅛	......	......	......	......	All	None
Nebraska												
Custer	30,000	......	......	......	40	......	......	......	......	Clay & straw, 8	All	None
Knox	20,000	......	......	......	......	......	......	......	......	Grading, 60	All	None
Platte	105,734	......	......	......	......	......	......	......	$65,734	Bridges, $40,000	$30,000	All other
Saline	30,000	......	......	......	......	......	......	......	......	......		
Wayne	75,000	......	......	......	......	......	......	......	All	......	50%	50%
New Jersey												
Burlington	775,000	......	......	......	......	......	$75,000	......	......	Sheet asphalt, $400,000; maintenance, $300,000	$150,000	$625,000
Hunterdon	130,000	......	1	......	......	......	......	......	......	Maintenance	All	None
Mercer	......	......	......	4,267	......	44,631	......	3,300	......	Sheet asphalt, $17,000	None	All

COUNTY HIGHWAY WORK DONE DURING 1919 (Continued).

State and County	Amount of county, state and federal money spent.	Bituminous concr. miles or sq. yds.	Bituminous macadam miles or sq. yds.	Plain macadam miles or sq. yds.	Sand-clay miles or sq. yds.	Gravel miles or sq. yds.	Cement concrete miles or sq. yds.	Brick miles or sq. yds.	Earth miles or sq. yds.	Other work.	Done by county or state forces	Done by contract
Passaic	595,813	3.1		2.25			3.2			Sheet asphalt, 0.65, repairing 155 mi.	Repairing & Oiling	All other
Somerset	140,817			6						Various kinds	All other	All macadam
Union		24,663					19,212					
New York												
Chenango	79,000		3.75	3.45		5					All	None
Cattaraugus	256,425										None	All
Chautauqua	73,174										None	All
Erie	206,555										None	All
Lewis	140,173		All								$59,100	$81,073
Niagara	86,399										None	All
Otsego	95,000						1.35				None	All
Schenectady	125,360			11.95			1.92			Repairs, $14,339	$14,339	$81,021
North Carolina												
Person	80,000								10		Maintenance	Construction
Union											All	None
Washington	15,000				Maint.						All	None
North Dakota												
Williams	100,000								76			
Ohio												
Ashland				4.5				10			Macadam	Brick
Carroll	50,000			3						Cinder, 5	Cinder	Macadam
Champaign	100,000			Part		Part						5 miles
Clark	305,205		9.4							Maintenance & repairs	$56,000	$249,205
Coshocton	198,339			2.6 re- surface								
Darke	620,000					$175,463	25 $274,193	26 $170,344			Macadam	All other All
Erie	200,000			10			4				50%	50%
Fairfield	125,000			5			1⅓					
Fulton	340,000			22		6				State road, 8	8	28
Hancock	120,768	All									None	All
Henry	228,034			16		2					None	All
Highland	600,000		8	20		6					Macadam, 2	All other
Holmes	110,847					4.85	0.16			Grading, 3.59	None	All
Huron	268,000			2.25			5.4	7.68			None	All
Jefferson	140,000			Maint.				2			50%	50%
Logan	140,000					Part	Part					
Madison	281,731		8.39	2.27						Loose stone, 2; maintenance, $60,000	Maintenance	Construction
Muskingum	46,120		0.45				0.6				None	All
Ottawa	300,000						$100,935					
Preble	145,227		2.25							Maintenance	Maintenance	Construction
Putnam	269,000		2	3						Loose stone, 7	2.35	9.65
Richland	562,970		5.75	3		15	4.25	0.25		By state, 3.5	None	All
Sandusky	400,000			9				5.74			None	All
Shelby	80,000		1.75				3.5				None	All
Stark			6.4	1.3				1.6			None	All
Summit	236,814	75,570						2,208		Stone block, 1,800	None	All
Tuscarawas	75,000						2.34				None	All
Williams	350,000	2	12	11			6				None	All
Oklahoma												
Choctaw	50,000								All		Grading	Culverts
Craig	40,000								All		50%	50%
Kingfisher	121,411								All	Bridges	Over half	
Muskogee	137,000									Sheet asphalt, 2.5	None	All
Pottawatomie	571,000				All						$166,000	$405,000
South Carolina												
Cherokee	175,000				25					Clay-stone, 3	Clay-stone	Sand-clay
Chester	200,000				All						$150,000	$50,000
Greenwood	115,000				10					Maintenance, $55,000	Maintenance	Construction
Lancaster	53,000											
South Dakota												
Beadle	101,668								15	Bridges, $54,000	All	None
Clay	56,347								$12,595	Bridges, $39,193; maintenance, $4,258.	$14,511	All other

Codington	50,030	......	......	......	......	8	......	......	28	......	24	12
Custer	35,000	......	......	......	......	......	......	......	43	......	All	None
Davison	43,000	......	......	......	......	......	......	......	All	......	All	None
Gregory	65,000	......	......	......	......	......	......	......	50	......	$60,000	$5,000
Haakon	8,000	......	......	......	......	......	......	......	29	......	All	None
Jackson	13,000	......	......	......	......	......	......	......	......	......	All	None
Meade	22,000	......	......	......	......	......	......	......	42	Hard surface, 83	42	3
Miner	9,000	......	......	......	......	......	......	......	......	Clay	All	None
Spink	45,000	......	......	......	......	......	......	......	100	......	83	17
Tripp	60,000	......	......	......	......	......	......	......	70	......	All	None
Walworth	40,000	......	......	......	......	......	......	......	60	......	All	None
Tennessee												
Cocke	30,000	......	......	3	......	1	......	......	......	Grading, 16	All	None
Giles	128,060‡	......	......	15	......	70	......	......	......	Grading	......	......
Greene	101,585	......	......	14	......	......	......	......	38	......	None	All
Hamilton	100,000	......	......	$20,000	......	......	......	......	......	Oiling, $20,000; chert, $10,000; maint., $50,000	$80,000	$20,000
Hawkins	25,000	......	......	......	......	......	......	......	......	Grading, 150	Most	.....
Lewis	50,000	......	......	......	......	......	......	......	18	Repairs, $7	12	13
Roane	85,000	......	......	......	......	......	......	......	......	Grading	All	None
Wilson	30,000	......	......	5 rebuilt	......	......	......	......	......	Repairs	All	None
Utah												
Carbon, Duchesne, Emery, Grand, San Juan & Uinta	100,000	......	......	......	......	......	......	......	69	......	Half	Half
Vermont												
Bennington	23,262	......	......	......	22,084	......	......	......	......	......	All	None
Virginia												
Augusta	100,000	......	......	4.5	......	6	......	......	......	......	All	None
Campbell	100,000	......	3	......	......	......	......	......	......	"Grey soil,' 5	None	All
Fairfax	60,000	......	4.5	......	......	4	......	......	......	......	Bit. mac.	Gravel
Halifax	140,000	......	......	......	......	......	2	......	......	"Grey soil," 20	Soil	Concrete
Henrico	40,000	......	1.25	......	......	5	......	......	......	......	Gravel	Bit. Mac
Pittsylvania	145,000	......	4.5 resurf.	18	......	......	......	......	20	......	Macadam	......
Scott	125,000	......	......	5	......	......	......	......	......	Grading, 15	15	5
Wise	90,000	......	Part	Part	......	......	......	......	......	......	$70,000	$20,000
Washington												
Clallam	150,000	......	......	......	......	All	......	......	......	......	⅔	⅓
Kittitas	64,800	......	......	......	......	2	......	......	......	Grading, 2.4; Maintenance, $45,400	Maintenance	Construction
Lincoln					......	29	......	......	......	......	......	23
Okanogan	309,000	......	......	......	......	3.64	......	......	......	......	None	All
Pend Oreille	37,912	......	......	......	......	1.41	......	......	Some	......	$31,132	$6,780
Pierce	......	......	......	......	......	......	......	......	......	1, kind not stated	......	......
Spokane	......	12,433	......	68,700	......	23,500	92,500	......	......	......	......	......
West Virginia												
Brooke	300,000	......	......	2	......	......	......	6	......	Grading & maint., 180	......	Brick
Hancock	64,000	......	......	......	......	......	2	1.04	......	......	None	All
Harrison	250,000	......	......	......	......	......	3	3	......	......	None	All
Jackson	50,000	......	......	......	......	......	2.75	......	......	......	None	All
Kanawha	500,000	......	5	......	......	......	2	3	......	......	All	None
Mercer	30,000	......	0.75 reconstruction	......	......	......	......	......	......	Grading, 1	Bit. mac.	Grading
Mineral	79,000	......	3.5	......	......	......	0.25	......	......	Grading, 4	Macadam	All other
Monroe	39,000	......	......	1.5	......	......	......	......	......	......	All	None
Morgan	50,000	......	......	......	......	......	0.3	......	Maintenance	3 bridges	Maintenance	All other
Nicholas	90,000	......	......	......	......	......	......	......	9	Maintenance, $15,000	All	None
Pleasants	10,000	......	......	......	......	......	......	......	......	Grading, 5	All	None
Preston	100,000	......	2.5	......	......	......	2	......	......	Clay-stone, 3	Bit. mac.	All other
Putnam	56,000	......	......	......	......	......	3	......	......	Grading	1 grading	All other
Randolph	100,000	......	$35,000	......	......	......	......	......	Maint.-$15,000	Grading, $50,000	Most	......
Ritchie	65,000	......	......	......	......	......	0.5	......	......	Grading, 5	Grading	Concrete
Summers	40,100	......	......	......	......	......	......	......	Part	Drainage	None	All
Taylor	35,000	......	......	......	......	......	......	1.5	......	......	All	None
Wetzel	215,000	......	......	......	......	......	0.6	......	......	Grading, 2	All	None
Wisconsin												
Adams	40,000	......	......	......	8	......	......	......	......	......	All	None
Brown	250,000	......	......	......	......	25	7	......	......	......	Gravel	Concrete
Door	75,000	......	......	Part	......	Part	......	......	......	......	14	12
Grant	83,825	......	......	......	......	4.5	......	......	......	Grading, 9.5	$57,825	$26,000
Juneau	34,397	......	......	......	All	......	......	......	......	......	All	None
Milwaukee	470,500	1.1	......	......	......	......	16.75	......	......	......	None	All
Polk	82,000	......	......	......	......	......	......	......	All	......	All	None
Richland	150,000	......	......	......	......	......	2.75	......	......	......	0.75	2
Rock	295,657	......	......	......	......	14	7.33	......	......	......	None	All
Trempealeau	275,000	......	......	2	......	12	......	......	......	Grading, 17	Little	Most
Walworth	136,000	......	......	......	......	10	5.5	......	......	......	Gravel	Concrete

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*Sand-clay gravel, metal surfacing. †To be given a trap rock surface in 1920. §Three contracts let, but none completed. ‡Includes $100,000 for taxes worked out.

PRACTICE AS TO ROAD SHOULDERS.

State & County	Type of Road	Width of shoulder, ft	Material used on, or other treatment of shoulder.	Protection of edges of pavement.
Alabama:				
Calhoun ..	......	4	None	Concrete curb for brick road
Etowah	......	3-6	Gravel or chert	None
Monroe	22 ft gravel	5	Sod, Bermuda grass	....
Arkansas:				
Sevier	......	..	None	None
California:				
Fresno	All types	7	Oiled earth	None
Solano	Concrete	Narrow	Broken stone, oiled	None
Sutter	......	4.5	Old road material	Timber headers
Connecticut:				
Fairfield	......	5	Rolled spring and fall	Curb when possible
Delaware:				
Sussex	......	6 to 8	....	....
Florida:				
Bay	......	3	Sod, Bermuda grass	None
Dade	Macadam	Feather edge	....	None needed
Hillsborough . .	Brick	6	Shell	Granite or concrete curb
Levy	20 ft. brick	9	Rock	....
Idaho:				
Jerome	16 ft. gravel	4	Dirt	None
Illinois:				
Carroll	All, 12 ft.	6	None	None
Douglas	Macadam, brick and concrete	One side 4 ft. other side 12	Earth only	Needs none
Fulton	16 ft. brick	3	Dragging	Stone or monolithic curb
	16 ft. concr.	5		
Iroquois	10 to 15 ft.	7.5 to 10	Earth graded and dragged	None
Kane	18 ft. concrete	6	Earth	None
Lake	18 ft. concrete	6	Earth or old road material	None
Lawrence	9 to 15 ft.	7.5 to 10	Crushed stone for concr. or brk., none for macadam or gravel	None
Macoupin	16 ft. concrete	4	Gravel	None
Madison	10 ft. concrete	3	Macadam	None
Monroe	......	6	Graded earth	None
Pike	......	4	None	None
Schuyler	......	9 to 10	Earth	None
Wabash	......	6 to 8	Dragging and oiling	None
Warren	......	8.5	2.5 ft. gravel, 6 ft. earth	Curb for concrete or brick
Indiana:				
Adams	Macadam	4 to 6	None	None
Delaware	......	3	None	Curb for bituminous
De Kalb........	16 to 18 ft.	4	Rolled thoroughly	None
Franklin	12 ft. grv. & mac.	4	....	None
Fulton	12 ft. gravel	5	Rolled	Curb for concrete or brick
	14 ft. mac.	4	Rolled	....
Hancock	15 ft. c. or m.	3	None	....
	15 ft. gravel	2.5	None	....
Henry	16 ft. gravel	2	None	None
Howard	......	4 to 5	Rolling	Curb
Jennings	10 ft. gr. or mac.	5	....	....
Orange	9 ft. gr. or mac.	3	....	....
Posey	10 ft. gr. or mac.	7	None	No hard surface roads
Tippecanoe	Brick or gravel	4	None	None
Vermillion	......	4	Earth	Concrete curb for brick
Vigo	......	3 to 5	Earth, gravel or bit. macadam	Curbs for asphalt; concrete headers 3 ft. wide at crossings
Iowa:				
Cerro Gordo....	18 ft. concrete	3 to 4	....	None
Humboldt	......	4	....	....
Ida	26 ft. earth	6	....	No pavements
Johnson	......	..	Sodded earth	Curb for brick
Keokuk	18 ft. earth	4	....	None
Muscatine	16 ft. concrete	4	....	None
Sac	Gravel	..	Earth	....
Kentucky:				
Bell	12 ft. macadam	3	Earth	....
Boone	......	2 to 3	Rolled	....
Owen	......	3 to 5	None	None
Rockcastle	9 ft. macadam	5.5	None	None
	9 ft. gravel	3	None	None
Whitley	14 ft. macadam	3	Clay well rolled	Concrete curb
Louisiana:				
Avoyelles	14 ft. gravel	5	None	None
Richland	14 ft. gravel	5	None	None
Michigan:				
Cass	Gravel	7.5	None	None
	Concrete	4.5	....	....
Eaton	......	5.5 to 7.5	Clay or clay loam	....
Gogebic	16 ft. macadam	4	....	....
Luce	16 ft. macadam	4	Sodded	....
Macomb	......	4 or more	Stone or gravel	Curb
Marquette	......	3.4 to 4.5	Sodded or gravelled	....
Mecosta	12 ft. gravel	5	None	....
Muskegon	......	..	Sodded	None
Schoolcraft	......	4	None	....
Minnesota:				
Big Stone......	20 ft. gravel	3	....	....
Carlton	20 ft. gravel	2	....	....
Chisago	20 ft. gravel	3	....	....
	Pavements	6	....	....
Crow Wing.....	18 ft. gravel	3	None	None
	Concrete	6	....	....
Itasca	......	6	Screened gravel	Longit'l rod 6-in. fr. edge pave.
Jackson	Concrete	..	Gravel	....
Kanabec	......	2 to 4	Gravel	....
Kandiyohi ...	18 ft. concreto	6	Gravel	None
Waseca	20 ft. gravel	2	....	....
	18 ft. gravel	6	....	....
Watonwan	24 ft. gravel	3	....	....
Mississippi:				
Jefferson	12 ft. gravel	4	Dirt	....

PRACTICE AS TO ROAD SHOULDERS (Continued).

State & County	Type of Road	Width of shoulder, ft.	Material used on, or other treatment of shoulder.	Protection of edges of pavement.
Missouri:				
Callaway	9 ft. grav. or mac.	7.5	Earth	....
Harrison	10 ft. concrete	3	Bituminous	....
Jefferson	9 ft. g., 9 ft. grav. or mac., 10 ft. m.	3	None	None
Lincoln	16 ft. concrete	3	....	....
Mississippi	9 ft. concrete	4	Earth	....
		3.5 ft. gravel	and 4 ft. earth	....
Phelps	16 ft. gravel	4	None	....
Washington	9 ft. gravel.	3	Earth	....
Montana:				
Madison	16 ft. gravel	None	....	....
New Jersey:				
Burlington	18 ft. asph. & con.	6	None	Curb and paving guard
Hunterdon	16 ft. macadam	7	Earth	....
Mercer	18 ft. con. & mac.	3	Tar or oil dressing	Steel paving guard
Passaic	20-30 ft. conc. & bit. conc.	2 to 5	Tar or asphalt dressing or penetration macadam	....
Somerset	13 ft. macadam	8	Rolled earth	....
New York:				
Chenango	12 ft. macadam	5 or 6	Earth	....
Lewis	......	No standard	3 or 4 in. loose stone steep grades	One ft. No. 1 stone mixed with K. P., sloping down to shoulder
Otsego	16 ft. various	5	Gravel if soil is clay or silt	Concrete curb for bit. concrete
Schenectady	14-20 ft. various	7	6 in. broken stone 2 ft. wide	....
North Dakota:				
Barnes	20 ft. gravel	4	Earth	....
Williams	Earth	4	....	....
Ohio:				
Ashland	10 to 16 ft various	4	Rolling	....
Carroll	16 ft brick & mac.	5	None	Curbs for brick
Champaign	Conc. & bit. conc.	7	Graveled	....
Clark	12 to 16 ft various	5, 6 and 8	Dressed with 3 to 4 in. gr. ea. yr.	None
Coshocton	16 ft. various	5	None	Concrete breakers for macadam
Darke	Conc., bk., gravel	5	None	None
Erie	......	At least 5	....	....
Fairfield	State roads	5	Gravel	....
	County roads	3 to 5	None	....
Fulton	Mac. & bit. mac	5	Gravel for bit. macadam	....
Hancock	10 to 16 ft various	5	None	Curb
Henry	Various	5	Broken stone	....
Highland	......	..	Earth, dragged	....
Holmes	10 to 14 ft.	6 to 8	Gravel	Curb
Huron	10 ft. concrete	4 to 13	....	....
	16 ft. concrete	7	....	....
Jefferson	......	4	....	Curb for brick
Logan	......	3 to 5	Earth	....
Madison	Macadam	7	....	....
	Concrete	6	Earth, dragged each year	....
Muskingum	14 to 16 ft various	5	Loose limestone	....
Preble	16 ft. various	5	Earth, smoothed with grader	....
Putnam	Macadam &	..	Earth	....
	conc. brick	..	Concrete	....
Richland	......	5 and 6	Rolled	....
Sandusky	......	5 or more	....	Curb
Shelby	......	5	Earth	None
Stark	......	5 to 8	None	Conc. curb or 18-in. bit. shoulder
Summit	......	4 ft. one side,	12 ft. dirt road on the other	Gravel or slag shoulder
Tuscarawas	All types	5	Gravel	Curb
Williams	All types	5	Earth, sometimes scraped	4-in. conc. curb for bit. concr.
Oklahoma:				
Muskogee	......	3	Dirt	....
Pottawatomie	Sand-clay	4	None	....
South Carolina:				
Cherokee	......	4 to 6	Earth	....
Greenwood	Concrete	10	Top soil	....
Tennessee:				
Cocke	Macadam	6 and 8	None	....
Greene	......	3 and 4	....	....
Hamilton	......	4	With conc., chert with asph. oil	None
Lewis	......	6	....	....
Utah:				
Fifth District.	......	4	Earth	None
Virginia:				
Campbell	Macadam	3	Sometimes 2 ft. of crushed stone	Conc. curb when conc. base.
Fairfax	Macadam	3	Earth	....
Halifax	Concrete	3	None	None
Henrico	All types	3	Rolled and scraped regularly	None
Pittsylvania	......	3	Earth	....
Scott	......	4	Earth	....
Wise	......	3	....	None
Washington:				
Kittitas	......	4	Rolled	Wood curb for Warrenite on concrete, concrete curb for brick
Pierce	......	4	None	3x6-in. wood curb
Brooke	......	2	Earth	Concrete curb for brick
West Virginia:				
Hancock	......	4 & 4 or 2 & 9	Smoothed and rolled	....
Harrison	......	3 to 5	None	Curb
Kanawha	Conc. & asp. conc.	4	w. b. macadam	....
Mercer	......	3	None	....
Mineral	......	3	Broken stone and tarvia, tamped	....
Monroe	......	5	....	....
Morgan	Concrete	5	Shale and dirt	None
Pleasants	Earth	4	None	....
	Concrete	3	....	....
Preston	......	3 to 4	....	....
Putnam	9 ft. concrete	2.5	Stone, rolled	....
Randolph	......	3	Earth	....
Ritchie	Concrete	5	Earth	None; corners trowled
Summers	......	3.5	....	Flat curb
Taylor	Brick	3.5 and 4.5	....	Curb
Wetzel	Concrete	3	Sod	None
Wisconsin:				
Milwaukee	Concrete	5 on fills, 4 cuts	Dirt and gravel	Header for brick & sandstone, curb for asphalt
Richland	......	4.5	Earth	....
Rock	......	4.5	Earth	....
Trempealeau	9 ft.	5.5	....	....
	15 ft.	2.5	Rolled, sometimes scraped	....

RESURFACING COUNTY HIGHWAYS

State and County	Kind of pavement resurfaced	Material used for resurfacing	Age of old pavement	Treatment of old surface before adding new material	Cost of resurfacing per mile or sq. yd.	Use made of old materials
Alabama						
Calhoun	Macadam	Chert	5 yrs.	Scarified, shaped, rolled	$2,500	Used for base
Etowah	......	Tarvia, surface treatment	6 mos.	None	0.17	None removed
Arkansas						
Jefferson	Gravel	Penetration macadam	3 yrs.	Scarified and surfaced	4,000	None removed
Connecticut						
Fairfield	W. b. macadam	Tarvia B	2 to 8 yrs.	Scraped, holes filled, rolled, tarvia added	2.65	Repairing low spots
Florida						
Brevard	Shell	Shell	3 to 5 yrs.	....	....	....
Dade	Rock	Rock	5 to 10 yrs.	Scarified	1.23*	....
Hillsborough	Shell	Shell	1 to 10 yrs.	Nothing	....	....
Pasco	Macadam	Rock	5 yrs.	Scarified, widened, resurfaced	......	
Illinois						
Carroll	Gravel	Gravel	12 yrs.	Nothing	1,000	...
Douglas	Macadam	Gravel	4 to 8 yrs.	Scarified	900	.....
Lake	Stone and gravel	Stone & gravel, with tarvia	20 yrs. or more	Scarified and shaped	....	.....
Lawrence	Gravel & macadam	Gravel	3 to 6 yrs.	Scarified	800	
Madison	Macadam	Macadam and Novaculite gravel	8 to 10 yrs.	Scarified and harrowed	3,200	Rerolled with new mat'l
Pike	Gravel	Gravel	10 to 12 yrs.	Scarified and rolled	0.35	None removed
Wabash	Gravel	Gravel	6 yrs.	Grading and draining	1,000	......
Warren	Gravel	Gravel	12 yrs.	Scarified	0.25	....
Indiana						
Fulton	W. b. macadam	Gravel	4 yrs.	Scarified and rolled	....	None
Hancock	Gravel	Gravel	10 yrs.	....	....	.
	Bit. mac.	Tar	....	....	....	......
	W. b. mac.	Stone chips	5 yrs.	....	....	....
Orange	Gravel	Limestone	12 yrs.	Patched with gravel	1.00	....
Posey	Gravel	Gravel	20 yrs.	Scarified and resurfaced	5,000	....
Tippecanoe	Tarvia macadam	Fine stone and tarvia	9 yrs.	Low spots filled with emulsified mixture	325	None removed
Vigo	Bit. macadam	Concrete, 3½ inch, reinforced	10 yrs.	Cleaned and holes filled	3.75	....
	Brick & concrete	Emulsified asphalt	2 to 15 yrs.	Surface cleaned, cracks filled, loose material removed	1.50	....
	Gravel	Gravel	10 to 20 yrs.	Graded and dragged	1.00	....
Iowa						
Emmett	Gravel	Gravel	3 to 4 yrs.	....	....	....
Hamilton	Gravel	Gravel	1 to 3 yrs.	Nothing	1,000	....
Mitchell	Gravel	Gravel	2 yrs.	Nothing	.57	....
Scott	Macadam & gravel	Stone & gravel	10 yrs.	Scarified, reshaped, new material added, harrowed	1,000	....
Kentucky						
Boone	Macadam & gravel	Stone & gravel	5 to 20 yrs.	Scarifying and reshaping	5,000	....
Henderson	Macadam	Gravel, 6 in .thick	....	Scarified	....	....
Owen	Macadam	Crushed stone	....	Scarified	....	....
Michigan						
Cass	Gravel	Gravel	3 yrs.	None	1,200	....
Eaton	Gravel	Gravel	5 to 7 yrs.	....	.15†	......
Gogebic	Gravel	Gravel	7 yrs.	Gravel hauled and spread in winter, harrowed in spring	....	...
Luce	Macadam	Tarvia B and stone	5 yrs.	Filled holes with stone & K. P.	....	....
	Gravel	Gravel	4 yrs.	Scarified and reshaped	....	....
Mecosta	Gravel	Gravel	6 to 8 yrs.	Scarified and reshaped	600†	None removed
Muskegon	Macadam	Stone and tarvia	7 yrs.	Scarified and reshaped	2,500	None removed
Schoolcraft	Macadam	Stone, tarvia X.gravel	3 to 5 yrs.	Sprinkled, sometimes scarified	....	Making fills
Missouri						
Callaway	Gravel	Gravel	7 yrs.	Scarified	1,500	....
Jefferson	Macadam	Gravel & macadam	10 to 50 yrs.	Scraped with grader	2,000	None removed
Phelps	Gravel	Gravel	....	Scarified 4 in. deep	....	....
New Jersey						
Burlington	Macadam	Asphalt surface	Some 30 yrs.	Scarified and stone added	7,000	None removed
Hunterdon	W. b. macadam	Stone or slag with tarvia B and 65% asphalt	1 to 15 yrs.	Swept, patched with K. P.	.08 to .12	None removed
Mercer	Macadam	Sheet asphalt on 6 in. concrete base	12 and 18 yrs.	(a) Surface skimmed off; (b) macadam removed	2.00§	Filling
Somerset	W. b. macadam	Asphalt	10 to 25 yrs.	Scarified, 3 in. of 1½ stone, rolled, 1½ gal. of asphalt, ¾ in. of stone, ¾ gal. asphalt, rolled.	....	None removed

New York						
Chenango	W. b. macadam	Bit. macadam	3 yrs.	Scarified and shaped	5,000	None removed
Cattaraugus	Bit. macadam	1:1½:3 concrete reinf.	6 yrs.	Depressions filled with stone	2.84	On shoulders
	Bit. macadam	3 in. bit. macadam	....	....	1.09	....
Lewis	Bit. & w. b. mac.	Bituminous	5 to 8 yrs.	No scarifying. Removed entire surface in some cases	9,000	Filler in foundation course
Otsego	W. b. macadam	Concrete	12 yrs.	Scarified, reshaped, rolled, rebuilt shoulders, cleaned ditches	26,000	For subgrade
Schenectady	W. b. macadam	Concrete	14 yrs.	Scarified and rerolled	5.00	As foundation
North Carolina						
Wilson	Macadam	Stone and tarvia	12 yrs.	Swept clean.	900	None removed
Ohio						
Ashland	W. b. mac., slag mac.	Crushed stone & Slag	6 and 8 yrs.	Scarified and rerolled	....	None
Carroll	W. b. macadam	Tarvia	7 yrs.	Swept clean	....	None removed
Champaign	W. b. macadam	Tar cut-back conc.	8 yrs.	Patched with t. c. b., swept with power broom and heavy stable brooms, given paint coat.	....	None removed
Clark	Bit macadam	Tarvia or asphalt by pressure tank & screenings.	2 to 8 yrs.	Swept with power broom, painted with asphalt, holes filled	.60	Filling
Coshocton	Macadam	Monolithic brick	8 mo.	Swept, depressions filled with concrete.	30,000	....
	Macadam	Tarvia X	1 yr.	Swept, holes filled with cut-back.	1,200	....
Darke	Gravel	Gravel	15 yrs.	Shaping with scraper.	....	None removed
Erie	Bit. macadam	Asphalt and tar	2 to 9 yrs.	....	....	....
Fulton	W. b. macadam	Stone and gravel	....	Nothing	6,000	....
Hancock	W. b. macadam	Penetrat'n treatment	5 yrs.	Thoroughly brushed with steel broom.	1,250	....
Highland	W. b. & bit. mac.	Tar and stone	5 yrs.	Holes filled, new top course	.75	None removed
Holmes	Macadam	Tar and gravel	....	Swept with horse-drawn wire broom	.15	None
Madison	W. b. macadam	Tar and stone chips	4 yrs.	Patched with t. c. b. and stone.	1,000	None removed
Muskingum	Bit. macadam	Pea gravel or limestone screenings & tarvia.	2 and 3 yrs.	Patched with t. c. b. and stone.	.08	On shoulders
Preble	Bit. & w. b. mac.	Tar and hot oil	2 to 5 yrs.	Holes and ruts filled	1,200	....
Putnam	W. b. macadam	Tar surfacing	3 to 5 yrs.	Swept.	700	....
Richland	W. b. & tar mac.	Tar and limestone	5 to 12 yrs.	Patched with K. P. and stone, swept clean, tarred by pressure distributor.	900	....
Sandusky	W. b. macadam	Tar and stone chips	2 yrs.	Swept clean.	....	....
Shelby	Bit. macadam	Hot oil	1 yr.	Nothing	1,000	....
Tuscarawas	Brick	7 in. concrete	13 yrs.	Cleaned	2.00	....
Williams	W. b. & bit. mac.	Tar and stone chips or gravel	3 or 4 yrs.	Swept with rotary broom and hand brooms. Holes patched with t. c. b. and chips; two applications of tar (⅓ gal. each) and chips or pea gravel.	1,200‡	None removed
South Carolina						
Cherokee	Stone-clay	Screenings and dust	2 yrs.	Scarified	1,000	None removed
Tennessee						
Hamilton	Chert	Asphalt oil	3 yrs.	Holes leveled up.	.12	....
Vermont						
Bennington	Gravel	Gravel	4 to 7 yrs.	Nothing	2,112	....
Virginia						
Augusta	W. b. macadam	Asphalt	1 to 10 yrs.	Swept and patched	....	....
Fairfax	W. b. Macadam	Bit. macadam, 3"x14'	5 or 6 yrs.	A few sections scarified; rest not disturbed	12,000	None removed
	Gravel	Gravel	5 or 6 yrs.	....	....	....
Henrico	Gravel	Gravel, 3" to 8"	3 yrs.	Scarified and shaped	2,500	None
Pittsylvania	W. b. macadam	Bit. macadam	11 yrs.	Nothing	2.25	....
Wise	W. b. macadam	W. b. macadam	5 yrs.	....	.75	None removed
Washington						
Lincoln	Macadam	Fine crushed gravel	5 yrs.	Scarified	1,200	None removed
	Gravel	Fine crushed gravel	2 yrs.	Scarified	1,200	None removed
West Virginia						
Harrison	Bit. macadam	Tarvia X and K. P.	5 yrs	Thoroughly swept.	....	None
Mercer	W. b. & bit. mac.	Limestone & oil or tar	4 to 5 yrs.	Surfaced	1.40	None
Mineral	Bit. macadam	Limestone chips & tar	3 yrs.	Swept and repaired.	200	For shoulders
Wisconsin						
Grant	Macadam	Bit. macadam	10 to 12 yrs.	Leveled up with stone	1.01	None
Juneau	Macadam	Road oil & pea gravel	5 yrs.	Scarified	.20	None removed
Milwaukee	Concrete	Asphaltic concrete	7 yrs.	Thoroughly swept, removed old tar, widened concrete 6 ft.	2.06**	None removed
Rock	Gravel	Gravel	5 to 10 yrs.	Scarified and rolled, rebuilt shoulders	1,920	For base
Trempealeau	Macadam	Gravel or stone	5 yrs.	....	2,500	For base
Walworth	W. b. macadam	Crushed gravel	6 to 8 yrs.	Scarified	2,000	....

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*Per cubic yard of new shell. †For gravel. §For sheet asphalt, 1½ in. top on 1½ in. binder. ‡Does not include patching holes. State applied tar at cost of 6⅔ cts. per square yard. **For the asphaltic concrete; includes cost of extra thickness where concrete was badly worn.

MAINTENANCE OF WATER-BOUND MACADAM COUNTY HIGHWAYS

State and county	Miles in the county in 1919	Average width, in ft	Amount spent for maintenance in 1919.	For a period of years Average spent per mile per year.	Number of years averaged.	Travel on the roads in question, average per day.
Alabama:						
[illegible]n	10	10	$200	25	5	100 motor cars
Etowah	15	16	Nothing	200*	4	200 wagons and cars
California:						
Plumas	350	10	20,000	....	....	Motor vehicles 9 mos. snowbound 3
Florida:						
Pasco	6	16	....	300	....	....
Illinois:						
Carroll	20	12	5,000	....	....	....
Douglas	35	10	5,000	100†	5	....
Kane	30	12	....	500	....	....
Lawrence	6	12	....	500	6	500 pleasure cars to 10-ton trucks
Madison	22	12	7,000	675	6	No data
Monroe	8.5	16	200	30	....	100
Pike	8	16	750	....	....	100 to 250 motors
Indiana:						
Adams	573	14	74,444	40§	10	....
Jennings	280	10	20,000	60	....	....
Shelby	30	12	....	100	3	Motor travel principally 500, 1 to 7 tons
Vigo	2	9	2	25	10	
Iowa:						
Scott	60	12	5,000	100	5	300 per day, average 1½ tons
Kentucky:						
Bell	20	12	Nothing	Nothing	3	To be surface treated this year
Boone	30	10	30,000	100 300	1914-1917 1917-1920	50 38-ton
Rockcastle	7	9	200	....	....	50, average 1 ton
Whitley	10	14	....	Nothing	2	10 autos, 3 trucks, 15 wagons
Michigan:						
Alger	30	16	28,000	75	1	200
Luce	10	16	6,000	110	....	175 pleasure cars
Marquette	13.8	15	6,551	....	....	....
Muskegon	40	12	60,000†	500†	3	1,200 autos
Schoolcraft	35	16	10,000	300	3	300 cars, 10 trucks
Minnesota:						
Big Stone	138	24	6,000	60	6	120 vehicles
Crow Wing	3	16	700	150	4	400 cars
Missouri:						
Callaway	7	9	200†	25†	4	300, average 2 tons
Jefferson	0.5	9	10	12	10	Autos and heavy trucks
Lincoln	25	10	Nothing	100	15	100
Montana:						
Beaverhead	4	20	Nothing	....	....	Heavy trucks and tourist travel
New Jersey:						
Burlington	150	14	....	1,500‡	....	Heavy
Hunterdon	70	16	70,000	500 to 1,000	....	100 to 200 autos
Mercer	40	16	1,588**	....	....	....
Passaic	155.1	20	269,820	1,100	2	Fairly heavy
Somerset	120	13	82,000	500	10	400 autos averaging 3 tons

Forgotten Items in Contracts

In a recent paper by D. S. Colburn, published in the *Contractors' Atlas*, the author analyzes the cost estimate of a 130 x 200-foot three-story school building for which the usual items of labor and materials, plus 10 per cent profit aggregated $139,243.96, and showed how the contractor stood to lose nearly all of his legitimate profit by overlooking a number of ordinary vital expenses that go to make up the necessary general cost or overhead expense.

These consisted of bonds, fire insurance, liability insurance, telephone, traveling expenses, temporary office, water supply for construction purposes, watchman, time-keeper, engineer for laying out, etc., protection of work, temporary heating, cleaning building, carting debris, and cutting and jobbing for other trades, making a total of $9,005 which, plus the original estimates and the 10 per cent profit on the whole, made the correct bid $149,149.46.

Even this addition is inadequate because neither estimates provided for interest on capital, office expenses, salaries, cost of estimating, waste deterioration of plant, loss of tools or contingencies which together should be provided for by several thousand dollars more according to the magnitude and nature of the contractor's total business.

Salt Water for Concrete

From observation made on concrete subjected to a moist tropical climate it is believed that the use of salt water for mixing the concrete in such localities is especially objectionable. In reinforced concrete elements and in sea walls made with salt water the steel began to rust within a few months and soon caused the formation of cracks, distortion, and discoloration of the concrete, apparently indicating a very short life for the structure which was at first in very good condition.

Heavy Side-Hill Cutting

Heavy grading for the construction of the 33-mile Dixon-Polson, Montana, branch of the Northern Pacific Railway was carried on by a Marion steam shovel working a side hill cut as deep as the boom could operate and loading directly into 10-yard side dump cars hauled in 10-car trains by a dinky

MAINTENANCE OF WATER-BOUND MACADAM COUNTY HIGHWAYS (Continued)

New York:						
Chenango	6	12	1,200	100	8	....
Cattaraugus ...	10.3	16	1,152	....	....	....
Chautauqua	4.1	16	1,712	....	....	....
Erie	85.9	13	681	....	....	....
Niagara	23.7	16	828	....	....	....
Lewis	21.1	16	6,300	360	2	242 autos, 20 trucks, 25 1-horse and 23 2-horse vehicles
Otsego	81	16	....	500	5	150 motor, 20 horse
Schenectady ...	31	14	25,600	....	....	250, average 1.5 tons
North Carolina:						
Union	4	10	None	....	....	75-light to medium
Wilson	20	14	900	600	2	100
Ohio:						
Ashland	28.2	12	30,000	4,000	8	Motor cars
Carroll	9.5	16	1,800	200	3	....
Champaign	16	13	14,000	350	8	....
Fairfield	15	12	60,000	300	5	....
Fulton	122.7	14	47,148	400	....	....
Hancock	739.3	10	10,000	....	.....	....
Highland	163.3	14	16,000†	60	5	....
Jefferson	240	10	65,000	....	....	....
Madison	17	14	2,000	120	4	....
Putnam	637	10	134,400	150	5	....
Richland	32	10	15,000	....	....	....
Sandusky	490	10	30,000	....	....	15
Tuscarawas	22.4	16	2,200	....	....	100 touring cars
Tennessee:						
Cocke	100	12	25,000	100	5	200, average 4,500 lbs.
Hamilton	4	16	....	600	....	....
Virginia:						
Augusta	80	12	25,000	230	5	....
Campbell	2	14	300	250	3	100 autos and wagons
Fairfax	20	12	10,300	....	....	11 miles heavy, rest moderate
Pittsylvania	24	14	15,600	....	....	....
Scott	40	12	30,000	900	3	....
Wise	80	11	30,000	....	....	200, all kinds
Washington:						
Lincoln	16	16	3,000†	200†	6	90 per cent. motor
Wisconsin:						
Adams........	3	9	600	150	3	....
Brown	200	9	60,000	....	....	500 cars
Door	200	9	30,000	150	....	....
Juneau	35	12	8,096	231	....	160, average 3,000 lbs.
Richland	12	9	8,000	660	2	....
Rock	10	9	1,095	100	3	....
Trempealeau ...	2	9	....	300	8	Heavy

Note: Unless otherwise stated, maintenance costs given include only labor and material.

*Includes overhead charges. †Maintenance costs include machinery upkeep and depreciation. §Now $110 a year. ‡Includes some overhead and some equipment. **Includes administration and truck maintenance.

locomotive and dumped from timber trestles permanently embedded in the high embankments. In order to install the dinky locomotive well in advance of the track-lying, it was chained and blocked on a pair of track rails mounted on a heavy truck and hauled a long distance across the country by a 10-horse team.

Preventing Pavement Deterioration

Editor, Public Works, New York City.

Dear Sir:

I have just read the article, "Resurfacing Old Pavements," in Public Works, issue of February 7. I agree with you almost entirely as to the suggested practice in such cases as described in that article. But confessedly I am impressed more deeply over the conditions found than the manner and method of repair. By this I do not mean that the manner and method of repair of conditions existing is not without deep concern, and inasmuch as we have that to contend with, a study of the best treatment is of course not out of place. But is it not the proper thing also to take into consideration what may be done to prevent a recurrence and growth of conditions such as this article discloses?

So this question comes to me while I am reading this article: Where non-uniform surface wear is found, a generally accepted theory is that it is due to the non-uniformity of the wearing material, whereas a close study of the conditions will in most cases, especially so in our smaller cities and on country highways, disclose the fact that the excessive wear is due to defective or non-uniform support of the wearing surface —the primary cause being found in the sub-structure.

Perhaps my recent plea for a better understanding of our sub-structure conditions and, if possible, a classification of soils which may characterize their absorptive and capillary qualities for the retention and absorption of moisture, is the influence that causes me to write you this letter. If we better understood this soil quality, the second step might be easily applied, namely, the necessary treatment to stabilize it. If, therefore, we knew what we were dealing with and could treat our sub-structure conditions efficiently and sufficiently to furnish adequate support to the wearing surface of our pavements, the injury which calls for millions for resurfacing purposes would be limited to the friction of abrasion wear from the traffic. If this vision or possibility could be realized, it is not difficult to conceive millions of dollars that might be saved.

A good many agencies are at work upon this problem. Ultimate success in solving it depends upon the persistency and energy and the financial means to pursue.

Let us hope for early results.

Yours very truly,

WILL P. BLAIR,

Vice-President, National Paving Brick Manufacturers' Association.

The Nation-wide Demand for Improved Highways

At a regular meeting in New York, March 17, of the American Society of Civil Engineers, the subject of the nation-wide demand for improved highways was covered by a program including addresses from a number of men identified with road construction, including highway officials, consulting engineers and others who have had large experience and spoke with authority. The principal topics were: A General Survey of the Highway Situation; An Historical Sketch of Traffic and Types; How Much Can We Afford to Spend for Highways Per Mile?; Permissible Cost Based on Saving in Hauling; The Need for Adequate Maintenance—Its Bearing on First Cost; Suggestions on How to Complete the 1920 Program of Highway Construction; and Permanent Highways as an Aid to Railroads.

The discussion was opened by H. G. Shirley, secretary of the Highway Industry Association, Washington, D. C., whose text was the Nation-wide Demand for Improved Highways. Mr. Shirley enumerated 24 states that had either provided for, are about to provide for, or are legislating to permit the appropriation of large amounts of roadway funds varying in some specific cases mentioned from $25,000,000 in Mississippi to $90,000,000 in Minnesota and $100,000,000 in Texas. Although these sums aggregate a large amount, it is very small in comparison with what is needed.

MORE THAN 2,000,000 MILES OF ROAD IMPROVEMENT REQUIRED.

There are in this country about 2,500,000 miles of roads, not more than about 10 per cent of which can now be called good roads. During the last ten or fifteen years these roads have been subjected to a traffic ten times as fast as the former traffic, due to the use of 7,000,000 automobiles that at a low estimate will increase 1,000,000 vehicles a year at the present time. New roads are being opened and partly completed at the rate of about 55,000 miles per year, but they are really being finished only at the rate of about 5,000 miles per year when they should be constructed at the rate of at least 20,000 miles per year as the first job before the American people.

We must not think that we are now meeting and solving this problem: it is fully equal to the original railroad problem, and with the aid of the engineers, it must be solved within the next ten or twenty years if we wish this country to develop as it should. We will then have, with Federal aid, a system of national roads connecting with the main centers of population, passing through the productive areas, and connecting the isolated districts

We must certainly pay for our roads, and in payment should remember that money is only a medium of exchange and that today a man's labor will build just as many square yards as it ever did, that a bushel of corn will pay for just as much road as ever, and that we are as well able as ever to build now, even with inflated prices, as at any previous time.

Today there is being built a standard type of road in Delaware and roads with the same thickness are being built on gumbo soil in Illinois, over the shell cliffs of Wyoming, and in other places where the conditions are different. Therefore it is the problem of the engineer to make the best roads for the conditions encountered.

TRAFFIC AND TYPES.

W. G. B. Thompson, state highway engineer of New Jersey, reviewed some of the ancient historical roads commencing with the Appian Way, 125 miles long, which was built by the Romans nearly 2,300 years ago and is still in service. In this country the trails of early days were succeeded by clay and gravel roads developing under heavier traffic into Telford foundations of large stones packed by hand. Later they were provided with crushed stone surfaces forming macadam roads that, since the introduction of automobiles, have been treated with tar and asphalt surfaces in the interurban and rural districts as distinct from city pavements. The present problem is to devise a road that with different kinds of foundations, will be durable under the heavy traffic of automobiles and automobile trucks. The remarks were illustrated by a number of views on ancient and modern highways and bridges.

HOW MUCH CAN WE AFFORD TO SPEND FOR HIGHWAY PER MILE?

E. J. Mehren said that it is impossible to give an answer to this question since it always depends on conditions. It is, however, safe to say that road construction is not justified where its annual carrying charge, plus its maintenance, much exceeds the cost of maintaining the existing roads.

Before the war an annual maintenance charge of $750 per mile was not considered excessive and a pretty good concrete road 16 or 18 feet wide could be built under ordinary conditions for as little as $15,000 per mile. Now under abnormal conditions of construction and financing, it may be possible to build the same road for $20,000 per mile, giving an annual charge for the first year of about $1,900 per mile. Comparing this with the former charge of $750 for maintenance, there is a balance of about $1,100 a year in favor of maintaining the old roads.

At the present time the cost of building new roads is about 2½ times as much and the cost of maintenance about twice as much as before. I think that we should go slowly until the expense of road building comes down. The question of road building is wholly one of policy, to protect the public in spending its money efficiently. There is a general movement to restrict highway building.

PERMISSIBLE COST BASED ON SAVING IN HAULAGE.

George H. Pride, of the Heavy Haulage Co., said that road construction is the biggest enterprise that the world has even seen and to which the Panama Canal was a mere bagatel. The road engineer is not to be looked upon as a wonderful magician, but as a man who is spending our money, and what is he giving us for it?

The road must not be considered separately, but in connection with the vehicles that are operated on it. With a 5-ton truck under ordinary conditions, the average ton-mile cost of hauling, properly calculated, is about 25c.

When a traffic of 500 tons of freight in 24 hours can be assured for a road, it will mean, under present conditions, a saving of $19,000 a year on railroad rates, which would certainly justify the construction of very high cost roads. Besides this, the 7,000,000 pleasure automobiles would easily save $100 a year by running over good roads instead of poor roads.

Traffic is a wonderful business barometer and if a new road shows a heavy increase of traffic, it demonstrates the prosperity of the community. The owner of a motor truck may be accused of damaging the roads, but in reality he is very anxious to cooperate in their improvements and maintenance.

In certain sections of the south, land worth $15 an acre immediately increased in value to $20 or even $30 an acre when bond issues were authorized even before any operations were actually undertaken for road building.

Road building cannot be stopped, the engineers must carry it on when it is demanded, and notwithstanding the high prices it would not probably be now suspended in Illinois if it were possible to be assured of materials and labor. So far, roads have been built with different kinds of aggregate, but now it is desirable that the use of steel should be seriously considered to make some sort of track.

THE NEED FOR ADEQUATE MAINTENANCE, ITS BEARING ON FIRST COST.

H. Eltinge Breed, consulting highway engineer, said that it was important to keep the roads in condition to function properly by attention to the drainage whenever soil conditions are bad, by a constant patrol system, and by reconstructing the surface whenever the annual maintenance becomes overburdensome in cost and when there is great loss of time in carrying on maintenance work, as for instance, when it is necessary to detour 500 cars a day one mile around a piece of reconstruction which will cost $30 a day or $3,000 for 100 days, which is not too long to allow.

Maintenance work should be completed early in the season and much is facilitated by an adequate budget with full details. When New York State commenced to build roads in 1909, a million dollars was appropriated for their maintenance and the amount has fluctuated since then up to $5,000,000 for maintenance in 1919. These appropriations were, however, from 30 to 50 per cent less than the amounts requested, and today the state is in need of enormous maintenance expenditures. It is, therefore, the duty of engineers to make accurate estimates of the cost of the work and for the public to support them in receiving the full amount needed. The high cost is largely due to the presence of traffic different from that for which the roads were originally designed, and to the congested condition of inadequate roads. The proportion of motor traffic increased from 15 per cent in 1916 to 30 per cent in 1918 on trunk lines near New York City, in the Susquehanna Valley, and in Western New York.

SUGGESTIONS ON HOW TO COMPLETE THE 1920 PROGRAM OF HIGHWAY CONSTRUCTION.

H. E. Hiltz, principal assistant engineer of the Pennsylvania State Highway Department stated that the $110,000,000 at present available for the primary road system in Pennsylvania will be used with the intention that the road shall be built so as to outlast the life of the bonds, and have something to start with after the 20-year period. Maintenace costs are paid for by automobile taxes.

We make full use of newspapers to speed up the work, sending them for publication maps of detours and information about new improvements, the kind of traffic, location, sub-constracts, prices and the like, and we also send special information to large users of the roads.

An engineering paper recently commented on the high prices paid for road building in Pennsylvania and all of the state contracts were forthwith analyzed by four men, one of them from the standpoint of the business man, the second from that of the contractor, the third from that of the engineer, and the fourth from that of the expenditure of public money. One contract at $60,000 per mile was for a vital link in a main line road where no road existed and rock excavation of from 30 to 80 feet was encountered. Another contract at $40,600 per mile was at a place where the roads at certain seasons were absolutely impassable. A third contract at $93,900 per mile is in a borough street requiring a pavement 30 feet wide with 20-inch curbs on both sides costing about $52,000 per mile.

All of this year's program was laid out and surveys completed last year for primary improvements this year. All of the inspectors were retained, put on survey work and in the winter doing sliding work so that the organization was ready to handle 400 contracts to be in force on May 1st. In these days when a contractor is paying from $300 to $500 a day for his gang, he does not wish to wait for decisions on specifications and the latter must therefore be clear and decisions should be made immediately.

We believe in the development of local supplies of stone and sand and not only examine but thoroughly test both materials by opening sand pits and by blowing out ledges and in this way our testing department has developed local supplies aggregating 600,000 cubic yards of stone. We list the supplies to the contractors and are glad to have them utilize them even though they may bid at a rate of perhaps $2.00 a ton when they get out the aggregate at $1.25 per ton.

In designing the roads of the primary systems the type is made to conform with the local conditions, as for instance in building sheet asphalt or bituminous concrete on brick bases, concrete bases or reinforced concrete bases according to local conditions.

In order to speed up the work, the contractor must furnish, before he receives award, assurances of his satisfactory equipment and finances. The department makes out a list of equipment needed for a certain contract and the bidder is informed that he must provide himself with it.

In some departments the contractor is required to have financial resources of 20 per cent of the contract, thus giving him sufficient capital to buy his materials and carry on the work before the monthly estimates come in. On the original contract the industrial system eliminates poor labor and the best contractors do not hesitate to pay high prices for satisfactory men; one of them starting his work last September with $7 labor accomplished more than others who commenced the first of May with $3.50 labor.

Labor turnover is a very serious problem but the payment of $6 and $7 a day and the installation of industrial equipment almost eliminate it. In Pennsylvania where we have many hills we find that from 4 to 6 miles is the most economical section of road to be finished in one working season. The providing of mechanical equipment for road construction is a very important consideration and should be handled by engineer salesmen for the manufacturers. In many cases, the work is examined by the representatives of the equipment people and vital information is given to the contractor before he makes his bid.

PERMANENT HIGHWAY AS AN AID TO RAILROADS.

Robert S. Parsons, New Jersey State Highway Commissioner and chief engineer of the Erie Railroad, said that permanent highways are of unquestionable aid to railroads by relieving them from unprofitable traffic which they must otherwise serve. Permanent highways should be used as branch lines, as connectors of miscellaneous freight in general, to relieve railroads of short-haul traffic in congested territories surrounding cities, to supplant waterways where boat traffic is extraordinarily expensive, to enable motor trucks to perform service, and for the development of inland freight stations.

In many cases it might pay to tear up branch railroads and use their road beds for the construction of highways which would not only serve the trunk line as well as the branches, but would also provide public highways. Trucks run on them from loading to unloading points save handling.

A method might be developed by which railroads could well afford to furnish trucks to operate for nearby towns to railroad stations. When railroad facilities in towns become congested, they may sometimes be relieved by the elimination of short-haul freight by the use of motor trucks that would deliver the freight assigned to the town within a radius of about 30 miles and carry truck farm products on the return trips. A very costly lighterage in New York eats up the entire profit on all short-haul traffic there, may be greatly relieved by the use of motor trucks operating direct from the New York warehouse to the New Jersey car yard for which purpose the proposed Hudson River Vehicular Tunnel may be classed as a permanent highway.

The so-called ferry car moving from door to door of various plants to assemble miscellaneous loads and carry them to a transfer point where they are separated for their final destinations is a losing proposition and the work could better be performed much more cheaply by motor trucks over a good road.

Very expensive development of freight tracks and grade crossings may be eliminated by establishing on cheap vacant property freight sheds containing removable truck bodies that can receive all the freight originating in that vicinity, be moved to a central station in the railroad yards and there loaded on cars and run to the proper destination.

Submerged Gravel Storage

In providing for a large winter storage of gravel under water, the Granite, Sand & Gravel Co., Indianapolis, Ind., have utilized an exhausted gravel pit, provided for the extension of gravel excavation beyond former limits, have completely utilized the established screening plant without change, have reduced the cost of excavation, have separated their plant into two independently operating units reducing overhead and waste expenses, and have increased their total capacity of production from 10 to 15 carloads per day.

The original plant consisted of a cableway about 600 feet long on which was operated a 2-yard Sauerman dragline bucket that had excavated, to a depth of 40 feet below water level, an elliptical area about 500 feet wide and 1,200 feet long and had delivered the gravel to a screening and loading plant adjacent to the railroad track at one end of the cable.

After six years' operation, the dragline excavator had reached its limits and some other methods had to be devised for excavating the gravel and delivering it to the screening plant. A floating 1¼-yard clamshell dredge was therefore installed in the pool and attacked the edges of the banks beyond the reach of the dragline bucket. The overburden, averaging 3 feet, is allowed to fall into the water when the bank is undercut, thus saving a stripping cost of about $2,500 per acre. The clamshell delivers to a 60-yard bottom-dump barge moored alongside which is propelled by a gasoline engine and transports the gravel to the center of the pool and dumps it under the cable where the dragline bucket reclaims it and delivers it, a distance of 200 or 300 feet, to the screening plant where it is handled at the rate of about 2 yards per minute. By this arrangement, the excavation and storage of gravel can go on continuously whether the screening plant is operated or not, and a large accumulation of gravel may be held in readiness for any demands.

Argentina's Public Improvements

Various projects of importance in Argentina are in progress. Floating docks, costing more than a million and a half dollars, are to be built by the government at various ports on the Parana, Paraguay and Uruguay rivers. An appropriation of $820,000 has been made for harbor improvements at Rosario.

Water service is to be provided in all communities having a population of 3,000 people or more, and both sewer and water service for all towns of 8,000 or more inhabitants, at an estimated cost of 15,000,000 pesos. A Portland cement factory, with a capacity of 300,000 tons annually, is to be established.

Work on the Rio Negro irrigation project, undertaken by the Buenos Aires Great Southern Railway, is reported to be progressing. About $5,000,000 is to be expended in this enterprise, which aims at the irrigation of about 325,000 acres.

Pitch pine water pipes 16 inches in diameter bored with 2-inch and 4-inch holes were laid in Boston in 1789, used continuously 51 years, and dug up in good condition after 130 years.

Natches- Selah Irrigation Works

Nearly seven miles of conduit built and repaired, including trestle and terrace flumes; lined canals; and 8,718 feet of lined rock tunnels, all concreted from several mixing plants supplied with aggregate dredged from adjacent river bed.

The Natches-Selah Irrigation System in the Yakima Valley, Washington, serves about 10,500 acres of orchard land by a long conduit carried through a mountainous region in tunnels, flumes and canals. The work includes the reconstruction of somewhat less than 3 miles of the original waterway and the building of nearly 4 miles of new structures. On this project there have been constructed since May, 1918, 8,718 feet of new tunnels, 3,100 feet of canal linings and 1,200 feet of flume both of reinforced concrete that were completed ready for service April 1, 1919. The work was designed and directed by Elbert M. Chandler, chief engineer, and was executed on the cost-plus-fixed-sum basis by the Nettleton Bruce Eschbach Co.

FLUMES.

The flumes are of two types, those seated directly on the bench terraced out of the side of the mountain, and those supported on trestle bents spaced 10 feet apart. The cross-section of the trough in both types is alike except that the bench flumes have an inside depth of only 5 feet, while that of the trestle flumes is 6 feet. They are designed to have a freeboard of 12 inches and a capacity of 135 second feet. The upper edges of the walls are tied together with tension-struts 6 feet apart and the walls and bottom are reinforced with 4 per cent of round steel bars. The concrete was mixed very wet and was poured continuously until each flume was finished.

The flumes and the canal linings were made with concrete mixed with aggregate from a bar in the stream, crushed when necessary, and delivered to the mixers at various plants located at convenient places for the different sections of the work.

CANAL LINING.

The canal, some of which is a revision of the old canal, has a regular cross-section so as to conform as nearly as possible with average conditions and made with sloping sides and sloping bottom cov-

MIXING CONCRETE FOR CANAL LINING IN PORTABLE MACHINES, AND DELIVERING IT ON PLANK RUNWAYS.

LINING BOTTOM AND SIDES OF CANAL WITH REINFORCED CONCRETE.

FLUME ON CONCRETE TRESTLE.

REINFORCEMENT IN PLACE FOR FLUME.

ered with 3 inches of concrete reinforced by 12 x 12-inch Clinton wire mesh made with No. 12 wire embedded 1½ inches from the surface. Transverse construction joints 5 feet apart longitudinally were scored ½ inch deep to fix contraction cracks.

In general the canals are in adobe or other soil that retains the moisture and on previous work has caused much trouble with frost. In order to prevent as much as possible temperature cracks the 1 : 2 : 4 concrete was placed in cold weather so that any cracks will close by expansion in summer time.

The wire mesh in rolls a little more than 6 feet wide was laid in longitudinal strips, two on the bottom and one on each side, and tied together on the edges with wire projections from the sides of the strips. The concrete was placed in two courses, plastered on the bottom and sides of the canal like mortar with the reinforcement placed on top of the first course and covered by the second course.

Aggregate and cement bags delivered alongside the canal by motor trucks were stored in heaps adjacent to the portable mixers with elevating charging hoppers that were moved at frequent intervals as the work progressed. The mixers discharged through open chutes supported at the lower end on light wooden towers where the discharge was controlled and the concrete delivered to two-wheel carts, pushed by hand over plank runways, dumped as required and shoveled and raked to position.

The cost of preparing the subgrade and building the lining averaged $2.66 per linear foot, equivalent to $0.66 per square yard of surface. The cost of the concrete lining in place including the reinforcement was $5.79 per linear foot, allowing $23.16 per cubic yard for concrete. Laborers received from $4.50 to $6.00 per day and were of inferior quality.

TUNNELS.

The tunnels have a horizontal floor, vertical side walls and segmental roofs with 2-foot rise. The uniform width of 7 feet was the most practicable minimum for construction operations and the height of the side walls varied from 4½ to 5 feet, according to grade. Except in timbered sections the concrete lining was generally 6 inches thick with a 4-inch floor over rock bottom.

With one exception, of a tunnel only 1,082 feet long which was through cemented gravel and large boulders, all of the eight tunnels aggregating 8,718 feet in length, were driven through soft dry sandstone or shale in which the holes for blasting were made with coal augers. The tunnels were driven in full size headings. At one time the double shifts on the double headings of five tunnels required twenty gangs that made an aggregate advance of 140 feet per day. The muck was hauled by mules and the tunnel was lined as soon as possible, because, although the rock stood well when first blasted, a long exposure made it very treacherous

CONCRETE PLANT.

Concrete was made with sand, gravel and crushed stone all dredged from the river bed with a 1½-yard dragline bucket operated from a 60-foot derrick boom. The sand was washed through the screens by a 2-inch centrifugal pump providing enough water to facilitate the loading into trucks by which it was delivered to the concrete mixers. Large stones were broken in an electric jaw crusher and the three storage bins were mounted on rollers and advanced by anchored tackles operated by the hoisting engine of the derrick whenever the extension of the pit required a movement to be made, usually every other day.

The derricks were similarly shifted on greased skids and hauled forward by the same tackles, these movements requiring about two hours. The plant was operated twelve hours a day by a five-man gang.

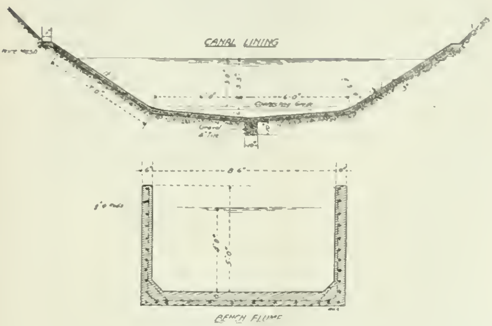
One of several mixing plants was installed on the top of a good sized hill that enabled the trucks to dump aggregate directly into the storage bins which delivered by gravity to the two-bag machine that was operated by one man and discharged through an open chute 150 feet long terminating with a spout to the portal one hundred feet vertically below it.

TUNNEL LINING.

Two 6 x 2-inch longitudinal strips of concrete were laid on the sides of the tunnel floor to support the wall forms and after the invert between the strips was concreted, the sectional wooden forms that were removed before the wooden arch forms were set, were wedged to position. The 4-foot sections of arch were concreted and rammed in about one-half hour by a four-man gang. The

FLUME AT TUNNEL ENTRANCE.

total cost of lining exclusive of engineering, including cost and contractors' compensation, was $103,834, averaging $23 per cubic yard. The total cost of the finished tunnels was $175,307, averaging $20.10 per linear foot. The inefficient labor received $4.50 per day.



STANDARD CROSS-SECTIONS OF FLUME AND CANAL.

Sacramento Valley Water Conservation and Irrigation

Up to 1917, the average flow of the Sacramento river has been 25,000,000 acree feet or more annually, but since 1917 it has been reduced to 14,000,000 acre feet or less, an amount that is still abundant for all needs if it is properly conserved. There are sites in the mountains for adequate reservoirs, but they have not yet been surveyed or developed and the details are not known, although it has been concluded that the big valley in Lassen County, which has long been considered an ideal reservoir site, is impracticable because the run-off would not be sufficient to fill in many years.

Frank Adams, irrigation expert in the United States Department of Agriculture, has presented a scheme for the organization of districts and the immediate construction of dams and reservoirs with state appropriations to be later repaid by assessments paid on the benefits of reclamation and irrigation in the flood control districts.

Col. R. B. Marshall, former geographer of the U. S. Geographical Society, has outlined a plan for a great system of canals covering the valleys from Shasta to San Francisco, at an estimated cost of $1,000,000,000, which would insure an abundant supply of water throughout the state at all seasons of the year and the cost of which would be more than repaid by charges levied on consumers after they had raised the first irrigation crop and were experiencing the benefits of the improvement. This scheme is expected to bring under cultivation millions of acres of land that are at present nonproductive. The California Water Congress passed a resolution unanimously calling upon Gov. Wm. E. Stevens to summon a special session of the Legislature to consider the water problem in the Sacramento Valley.

Deterioration of Labor

Contractors and other employers have long known that the quickest and surest way to demoralize and impair labor is to overpay it. Overpayment makes most men conceited and arrogant and not only breeds carelessness and indifference to their work but, by giving them larger resources, without provision for their wise disposal, permits them to enjoy more idle time and to indulge in extravagances and viciousness that unfit them for their work and decrease their ability as well as their inclination, thus affording the most convincing proofs that, for the best good of all concerned, every man should be paid according to his actual efficiency measured by direct products or total results.

The overpaid laborer is generally discontented, lazy, and ripe for trouble, despising, with more or less reason, the employer that submits to his insolence.

Disproportionate and unaccustomed wages, far from increasing efficiency, invariably decrease it, thus multiplying instead of reducing unit costs. This is demonstrated in a remarkably graphic manner by the accompanying picture, received from Bent Brothers, contractors, Los Angeles, of a scene on their job of installing a 42-in. concrete pipe at Oklahoma City. Here it takes nine men, at $4.50 per day, to handle a single section of the pipe that in 1916 was handled more rapidly and efficiently by three men at $2.50 per day.

The nine men do poorer work and do it slower, getting in each other's way, interfering, stopping to rest and talk and requiring much greater transportation, supervision and general expense than would three men. Note the gentle exercise shown in the picture; not a single back bent to honest work, no evidence of energy or efficiency, the men standing erect and indifferent and so numerous that they cannot even find room so that three of them are, quite suggestively, actually backing away from the work.

For the same gang the total daily wages have increased from $7.50 to $40.50 per day thus multiplying the nominal cost five and one-half times to

NINE MEN DOING WORK THAT THREE SHOULD DO.

say nothing of the additional difference caused by less and poorer work. Labor that gives such a return for such payment is playing the role either of a pauper or a robber or both and should be treated accordingly.

Protecting Contractors Against Rising Prices

In a contract to be let by the North Jersey District Water Supply Commission provision is made for changing the amounts to be paid the contractor to protect both him and the District against fluctuations in the cost of labor exceeding ten per cent.

The emergency work done by the Federal government in preparing for and conducting the war, and later the unusual conditions manifested in the rapid and considerable increases in wages and costs of materials, have resulted in a more or less general adoption of new ideas or modifications of old ideas in the awarding of contract work. Among these may be mentioned the several variations of cost-plus contracts.

More recently the innovations have been for the purpose of arranging between contractors and parties of the first part terms which shall enable contractors to bid upon work without either making an unduly high allowance in their bids for possible future increases in cost of labor and material or, on the other hand, incurring the possibility of bankruptcy through failure to sufficiently take into account such probable increases. In most cases this end is met by providing that the contractor shall be recompensed for certain classes of increases which may take place after the awarding of the contract, such increases including wages, freight rates, etc.

One of the latest contracts embodying such a provision is that prepared by the North Jersey District Water Supply Commission for the construction of the Wanaque dam, bids for which are to be received on April 27. This work involves a cost of more than $1,000,000, and comprises the construction of an earth dam and concrete and clay-puddle core wall. The particular feature of the contract referred to is quoted herewith in full, because of the interest which it may have for others who are contemplating making similar provisions in work about to be contracted for.

It will be noted that this article refers to wages only, and makes no provision for changes in freight rates. Most of the cost of the work, however, will consist of labor, the principal materials to be brought by rail being estimated at 140,000 barrels of cement, about 500,000 pounds of iron and other metals, and comparatively small amounts of pipe, lumber, etc. The article referred to is as follows:

Payment for Wages Above or Below Stipulated Rate.

Art. XL. To the end that the Contractor and the Commission may be protected, in so far as is practicable, against extraordinary fluctuations in the cost of labor, the Contractor shall make his bid on the basis of the following base scale of wages which is given on the information available to the Commission as the prevailing rate in Newark, N. J., upon the date of advertising this contract:

Trade or Occupation.	Base Scale of Wages.
Steam shovel man	$250.00 Month (26 days)
Craneman	50.00 Week (6-8 Hr. days)
Carpenter	8.00 Day (8 Hr.)
Mason	9.00 " "
Mason helper	5.60 " "
Concrete finisher	9.00 " "
Plumber	9.00 " "
Drill runner	7.00 " "
Tool sharpener	7.00 " "
Tool sharpener with pneumatic tool	7.50 " "
Pipe fitter	8.00 " "
Pipe fitter helper	6.00 " "
Engineman or engineer	46.00 Week (48 hours)
Fireman	150.00 Month
Rigger	8.00 Day
Machinist	1.00 Hour
Pile driver operator	50.00 Week
Electrical worker, inc. lineman	8.00 Day
Electrical worker helper	4.00 Day
Auto truck driver, 5 tons & up	35.00 Week
Auto truck driver, below 5 tons	30.00 Week
Teamster	25.00 Week
Laborer, 1st class (including working foreman, handy man and mechanics' helper not listed above)	.65 Hour
Laborer	.50 Hour

Time and one-half for overtime, double time for Sundays and holidays, except when otherwise stipulated, for monthly and weekly pay.

The Contractor shall file with the Commission, in such form and for such periods as the Commission shall stipulate, a record showing the name of all his employes, the hours worked, the wages paid to each and such other information as may be required.

If it shall be shown by the said record, to the satisfaction of the Commission, that a rate of wages more than 10 per cent in excess of the rate stipulated in the base scale has been paid for any of the above listed trades employed on this contract after December 31, 1920, and if said rates in excess of the base scale shall have been first determined by the Commission not to be unduly in excess of the then prevailing rates of pay on similar work, and are approved by the Commissios, then the Commission shall pay to the Contractor, in addition to the regular monthly estimate as provided in Arts. XXXI and XXXII a sum of money equal to the total amount of any such excesses of wages as have been actually incurred and paid after December 31, 1920, by the Contractor over said 10 per cent in excess of the base scale.

If on the contrary it shall be shown by the said record, to the satisfaction of the Commission, that a rate of wages 10 per cent or more below the base scale, has been incurred and paid in any of the listed trades during the period after December 31, 1920, then the Commission shall deduct from the net regular monthly estimates a sum of money equal to the total amount of any such differences betwen the rate actually paid by the Contractor and a rate 10 per cent below the base scale, or, if the Commission by its own investigation, after affording the Contractor an opportunity to be heard, shall find that the prevailing rates of pay on similar work for any of the listed trades are more than 10 per cent below the base scale, then the Commission may establish a new scale of wages predicated upon such prevailing rate and when such new scale is so established and copy thereof served upon the Contractor shall deduct from the succeeding monthly estimates, beginning thirty days thereafter, such sums of money as shall be equal to the difference between the rate 10 per cent below the base scale stated in the contract and the rates in said established new scale.

No extra payment shall be made for any trade or occupation other than those listed in the base scale unless the employment of workmen or mechanics of said trades is approved by the Engineer and a base wage for such new trade or occupation has been established in writing by the Commission. The base wage for any new trade so established shall always be held to obtain for the calendar year within which established and no payments for increase thereof nor deductions for decrease therefrom, as provided herein, shall be made until and for the year or years following.

No payment will be made under this article for wages paid to any workmen who may be accounted for under the provision of Art. XIV. With respect to labor costs not covered by payments directly under items, no adjustments under this article shall be made.

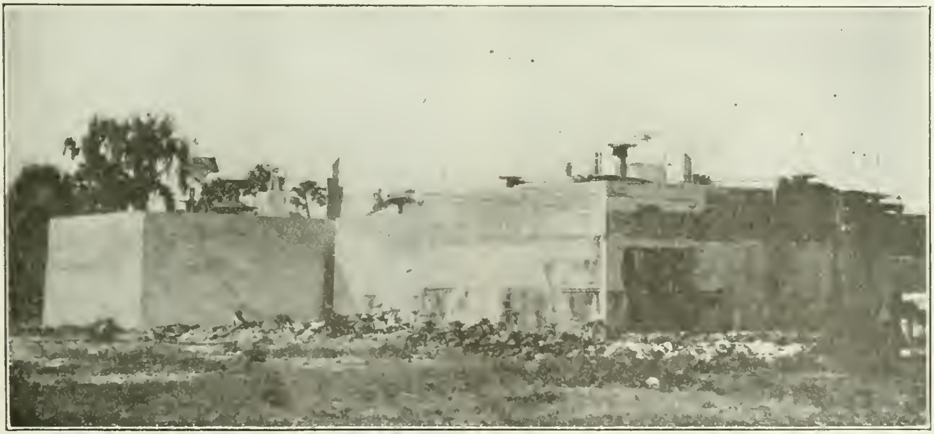
Article XXXI referred to provides for the customary monthly estimates, including in this an allowance for materials delivered on the site of the work at rates stated in the specifications; and Article XXXII provides for the payment of 90 per cent of the estimate within 30 days. Article XIV is one providing for extra work to be done at actual cost plus 15 per cent.

Water Softening in Florida

Hard, sulphur waters in Daytona and Palatka are aerated to release the sulphur gas and treated with lime, greatly improving them for domestic and boiler purposes. Artesian head of wells fills tanks in one city and partly fills them in the other, thus saving pumping.

About eleven years ago the Municipal Water Department of Daytona, Florida, installed a water softening plant to aid in improving the quality of the public supply, which plant was described by George A. Main in the October 11, 1911, issue of *Municipal Journal.* This plant operated satisfactorily, but with the improvement in the character of the water and the growth of the city, the consumption increased rapidly and the capacity of the plant was soon reached and exceeded, and three or four years ago the plant was doubled in capacity. The orignal plant contained three reinforced concrete hexagonal tanks with a total capacity of about 180,000 gallons, and an effective capacity of 150,000 gallons. The original tanks were built in horizontal sections, and there has always been more or less leakage through some of the horizontal joints between sections.

The new tanks are three in number and of the same shape and size as the old, but were built as monoliths, the concrete being poured into the forms continuously between five o'clock in the morning and nine o'clock of the following day. These tanks also are reinforced and can be filled to the full depth of 16 feet, giving them a capacity of 83,000 gallons. The tanks rest upon the ground surface, their walls extending entirely above the ground. In the center of each tank is a rising pipe and on top of this, about five feet higher than the top of the tank, is a horizontal table provided with a slotted raised edge of galvanized iron, which serves as an aerator, the water flowing through the slotted edge and in a circular cascade into the tank below. Water is forced through this riser pipe by a pump. In addition, there is an inlet pipe at the bottom of each tank which connects directly with the wells,



SEDIMENTATION TANKS OF WATER SOFTENING PLANT, DAYTONA.

The two lime-slaking tanks can be seen above the sedimentation tanks; also several of the aerating tables with their serrated edges. The old tanks are at the right, the new ones at the left.

AERATING WATER AT DAYTONA.

of which there are four, each 6 inches in diameter. The artesian head upon the wells is not sufficient to raise the water to the aerator, and the ordinary practice is to allow the tanks to fill about half full under the artesian head, when the water will begin to enter rather slowly. The remaining half is then filled by pumping from the wells through the riser and the aerator. The water is pumped into the tanks by a centrifugal pump rated at 1,000 gallons per minute.

The chief object of the aerator is to permit the escape of sulphur gases from the water, which is highly impregnated with sulphur, lime and magnesium. The aeration also results in the absorption of a certain amount of oxygen, and the result is a reduction in the amount of lime necessary to produce satisfactory softening. It is found that while 2.6 pounds of lime per thousand gallons is required for satisfactorily treating water introduced directly from the wells, 2.31 pounds is sufficient for water that has been pumped through the aerator; and it has been calculated that this saving in lime more than pays for the cost of pumping, the lift being only a few feet.

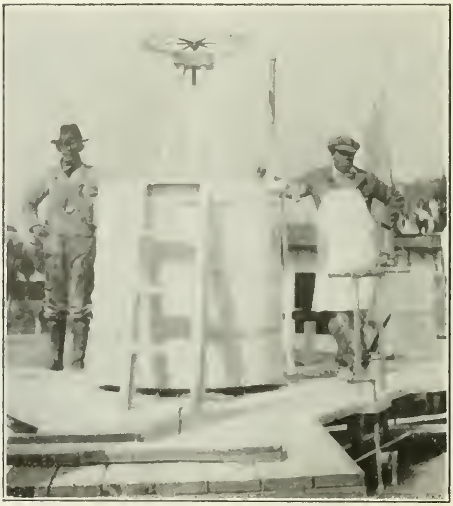
As told in the description of the original plant, the water is withdrawn from the tanks by a skimmer with float attachment. This consists of a pipe hinged, by means of a double elbow joint, to the outlet pipe in the bottom of the tank, and provided at its other end with a float which maintains the end of the pipe at a constant distance below the water surface, and also with a pan with a shallow rim which is so attached to the pipe as to be always approximately horizontal whatever the position of the hinged arm. Thus all the water is withdrawn from the surface and the lower water containing the sediment does not enter the mains.

The coagulation used is hydrated lime, the supply at the present being obtained from the Ohio Hydrate and Supply Company in 40-pound sacks, the cost of which a few weeks ago was 34 cents per sack. At the junction of each set of three hexagonal tanks, resting on the top of the wall, is located a lime slaking tank of wood, provided with a wooden paddle which is revolved by hand. About 600 gallons of water is run into one of these tanks, and the amount of lime required for the tankful of water is weighed on platform scales in the lime-house, and is dumped into the tank. This is then agitated by the hand-operated paddle until the lime is taken into solution. Before the lime water is run into the tank, air is admitted to the bottom of the tank through a grid of half-inch iron pipe laid in several lines across the bottom of the tank and provided with small holes. This thoroughly agitates the water, and when the entire tankful is boiling, the lime water is discharged from the lime tank. The paddles are kept going during the discharge, and when the tank is about three-quarters empty, water is allowed to run into and through it to wash out all of the contained lime. Air is applied for agitating the main tank for about an hour, securing a thorough intermixing of the lime water with that in the tank. The water in the tank is then allowed to stand for about twelve hours to settle, after which the water is drawn off into a clear-water basin, by means of the floating arm. The engineer believes that the result would be more satisfactory could the water stand for 24 or 36 hours, but this will be possible only if the plant is again doubled in size. The six tanks in use are treated in this way in succession. The clear water basin has a capacity of 74,000 gallons.

Lime and the suspended matter removed by it from the water collect in the bottoms of the tanks at the rate of about ½ inch per day. Each tank is cleaned out at intervals of from two to four weeks.

During the year 1919 the cost of aerating and purifying the water was $3,134, of which something over $2,000 was for lime. (The 1919 Annual Report does not itemize the several costs, but in 1918 the cost of aerating and purifying was $2,477, and during the same year the cost of lime was $1,794.)

In 1919 the cost of pumping was $5,118, as compared to $2,834 in 1918. In 1919 the cost of distributing was $518, as compared to $600 in 1918, and the overhead was $521, as compared to $735 in 1918. Plant repairs amounted to $2,142 in 1919 and $746 in 1918. In each year the interest on bonds was $2,500 and depreciation was charged at $1,900. In 1918, $5,863 was expended for salaries and wages, $1,616 for gasoline and oils, $250 for a



LIME SLAKING TANK, DAYTONA.

Ford truck and $2,210 for other materials and supplies, in addition to the lime already referred to. Adding $251 miscellaneous expenses and $762 refunding of meter deposits, etc., the total disbursements in 1918 were $12,746, while for 1919 the total was $18,567.

The pumping consists, in addition to operating the centrifugal pump for filling the tanks, of pumping the softened water from the clear-water basin into a circular steel tank 35 feet high, the bottom of which is 100 feet above the ground and the capacity of which is 75,000 gallons. In case of fire this tank is cut out from the distributing system and the pumps run the pressure up to between 85 and 95 pounds. The pumps used are Rumsey triplex plunger pumps, 12 inches in diameter and 14 inch stroke, operated by a 50 horse power Foos gas engine, 200 revolutions a minute This equipment is provided in duplicate. During the day the present consumption requires pumping about two-thirds of the time, and the pumps are run about two hours and are idle one hour. At night the pumps operate only about one-third of the time. During 1919 the amount pumped totaled 99,800,000 gallons.

There are about 1,200 services in the city, supplied by 922 taps. All of the consumers are metered. The population in summer is about 7,500, which is increased to between 10,000 and 20,000 during the winter.

For much of the above information and for courtesies shown at the plant we are indebted to Ben Tippins, the chief engineer of water works and sewers, and to F. J. Caldwell, first assistant engineer; also to E. L. Bond, Commissioner of Public Works.

WATER SOFTENING AT PALATKA.

The well water used for the public supply at Palatka, Florida, is very similar to that of Daytona, and following the successful operation of the original Daytona plant, a similar plant was installed at Palatka for treating the water. The plant construction, however, is considerably different.

There are three rectangular reservoirs for sedimentation, each 65 feet square and 8 feet deep, and holding 225,000 gallons. All of the water is aerated when entering the tanks. The aeration is secured by causing the entering water to flow through troughs which are supported above the top of the tank on a line extending diagonally across it, each trough being provided with openings at intervals through which the water is discharged in numerous small streams into the tank.

There are two 4-inch wells, one 6-inch and one 8-inch, which give a head of 20 to 25 feet above the ground surface. The sedimentation tanks are partly below the surface, and pumping is not required or employed in filling them. These wells give a natural flow of something over 1,000 gallons a minute.

The lime water is mixed in a wooden tank located at the corner common to the three sedimentation tanks, and is discharged into which ever tank is desired. The three tanks form three equal quarters of a large square, the fourth quarter of which under the lime-house, is occupied by a tank into which the sludge is withdrawn from the other three tanks. The water is agitated by compressed air admitted through a grid, the grid in each tank consisting of nine parallel lines of iron pipe laid in the bottom of the tank. After introducing lime and agitating, the water is allowed to stand seven hours before being drawn off into the clear-water basin, and this length of time appears to be satisfactory for this water. Each tank is cleaned about every 14 days, the sludge being withdrawn into the sludge tank and from this is washed into a stream. The hydrated lime used is obtained from the Florida Lime Company, and 1¼ pounds is used to a thousand gallons. In addition, there is used ¾ of a pound of soda ash 88 per cent, obtained from the A. S. D. Company.

SOFTENING PLANT, PALATKA.
Lime house in background. In foreground, aerating trough, supported on steel horses. At left bottom, hinged discharge arm, with float.

From the clear-water basin the water is pumped to a stand-pipe which has a capacity of 500,000 gallons. The consumption varies from 400,000 gallons to 700,000 gallons a day. Two compound, triplex pumps with a capacity of a half-million gallons each were installed in 1906 by the John H. McGowan Company. The stand-pipe gives a pressure of 65 pounds in the center of the town, which is raised to 100 pounds in case of fire. Also, the pressure is raised to 100 pounds once a month as a test of the strength of the pipes, joints, house connections and other appurtenances Compressed air is furnished by an air compressor supplied by the Chicago Pneumatic Tool Company. Steam for the plant is furnished by two 75-horsepower boilers burning wood which were constructed by the R. D. Cole Manufacturing Company of Newnan, Georgia. Superheated steam is used.

William A. Lyon was the engineer for the installation of this plant, which was later enlarged by S. C. Stallings, who was city engineer until last September. The softening plant was installed by Mr. Stallings in 1916, the consulting engineer being George A. Main, superintendent of the Daytona water works and the designer of the softening plant for that city. The present chief engineer of the municipal water works plant is E. Usina, to whom we are indebted for the above information.

In addition to this municipal plant, there is a private plant which furnishes about half of the city's supply, or about 500,000 gallons a day on the average. This plant was constructed in 1886, and is still using the Worthington compound duplex pumps and Worthington boilers which were installed at that time. This is one of the very few spring-water supplies in Florida. The supply seeps from low sand-hills into two gullies, down the bottoms of which it flows as surface streams into a basin. It passes through two sets of screens before entering the basin, and through two more screens between the basin and the pumps, by which all leaves, algae and other suspended matters are removed. This water is soft and receives no treatment. The basin is a shallow rectangular one with vertical brick walls. The water collected in this basin is raised to a standpipe. Pumping begins about 4.30 a. m. and continues to about 6.30 p. m., when the stand-pipe is left filled to provide the night consumption. The city has under consideration a proposition for purchasing this private supply.

A Good Roads Drive

Col. T. L. Kirkpatrick, president of the Charlotte-Ashville-Wilmington Highway Association, has appealed to all the North Carolina Good Roads leaders to join in a one-day drive to impress upon the Legislature the urgent need of a state wide system of permanent highways and demonstrate the public demand for them. This drive is expected to take the form of a convention meeting at Raleigh on the first day of the special legislative section about July 1.

It is intended to propose a $50,000,000 state bond issue, a $15,000,000 bond issue to pay for the portion of the Charlotte-Ashville-Wilmington Highway that traveres 16 counties of North Carolina, and a $1,000,000 bond issue by Mecklenburg County for renewing its macadam road system.

Road Material in Texas

The University of Texas has issued a report by Prof. J. P. Nash, Geologist with the Oil & Gas Department of the Texas Railroad Commission, that was primarily made to give details on road materials available for use in the U. S. Army in Texas, and extended to cover the entire state.

There are abundant supplies of gravel which has been largely used for the construction of mileage two or three times greater than that of any other type of road in this state. The most satisfactory gravel is found to contain between 60 and 70 per cent of pebbles between ¼ inch and 2 inches in diameter with sufficient sand to fill the interstices and a limited amount of clay for binder

There are many deposits of stone suitable for crushing that have not yet been thoroughly developed. There are deposits of granite in the central zone that can supply paving blocks suitable for heavy traffic, and there are many places where limestone with a coefficient of wear of more than ten and a compressive strength of more than 10,000 pounds per square inch can be procured.

For a distance of 100 miles from the coast, there are no natural deposits of satisfactory road materials so that first-class highways involve importing materials.

There are deposits of the best limestone and of granite and gneiss running in a north and south direction through the center of the state, gravel deposits in the river beds in the southwestern part of the state, trap rock, limestone and gravel in west Texas, but no good road material in and south of the Panhandle territory.

The Cost of Road Building

The latest advices from different sections of the country indicate that the promised reduction of high prices has not yet materialized in road building operations at least. In Chicago, it is estimated that the $60,000,000 bonds authorized by the state of Illinois will complete only one-third of the work originally planned. The present contract prices for new work average $42,000 per mile or 50 per cent in excess of the average contract prices a year ago, with the probability that this is a minimum and the cost will raise to $50,000 before the completion of the work.

In Dallas County, Texas, the commissioners have found that the highway system carefully estimated a year ago at $6,500,000 cannot be built now for anywhere near that sum, and that in Wichita County, roads that cost $40,000 per mile last year will cost about $70,000 this year, making the $2,000,000 bond issue that has been voted entirely inadequate for the system of concrete roads it was intended to construct. It is feared there that the effect of these costs will be a temptation, in order to secure the proposed mileage, to build new roads inferior in quality to those originally planned, which would be deplorable In both Texas and Illinois, it is recommended to defer extensive road building until conditions are more settled and exorbitant costs are reduced.

John W. Budd, superintendent of streets, Des Moines, states that the cost to property owners for paving was 72 per cent greater in 1919 than in 1910, and 63 per cent greater than in 1917 The costs per yard for each year from 1910 to 1919, inclusive, are respectively $2, $1.81, $1.75, $1.78, $1.94, $2.11, $2.57, and $3.45, showing the rapid increase to have occurred since the war.

In New Jersey, on March 22, Major F. A. Reimer, county engineer of Essex county, recommended to the County Board of Freeholders that all plans for new road construction be abandoned for the present year, although in January he had presented a program involving the expenditure of nearly $820,000. His reason was that, on the basis of prices now prevailing, new construction would cost approximately $10,000 a mile more than in 1919, or about 25 per cent. This deferring of new construction is possible because all the main highways are in excellent condition, and the main tributaries are of telford macadam in good condition. These can be maintained satisfactorily for $340,000.

Hydro-Electric Power for New Zealand

On account of the great difficulty in importing coal, the government of New Zealand has passed an act encouraging the development of hydro-electric power and has purchased a plant near Auckland, capable, with slight improvements, of developing about 12,000 h. p. Another plant, capable of producing 8,000 h. p., is now in operation and plans have been made for the developing of 160,000 more h. p., and it is hoped to provide sufficient hydro-electric power to make the country independent for manufacturing purposes.

NEWS OF THE SOCIETIES

April 7.—NATIONAL IMMIGRATION CONFERENCE, at Engineering Societies Building, New York City. Chairman of Board of Inter-Racial Council, Coleman du Pont, 120 Broadway, New York City.

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 27-29—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 4-6.—NATIONAL FIRE PROTECTION ASSOCIATION; Chicago. Secretary, 87 Milk street, Boston.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

American Railway Engineering Association.

The 21st annual convention at Congress Hotel, Chicago, March 16th-18th had a record attendance of 561 and received reports from 22 regular, and two special committees. The most important action was the adoption of new specifications for iron and steel structures and for steel rails. Among other important reports received were those of the track committee with new plans for frogs and switches; the railway location and operation committees' reports dealing with new punitive overtime rates of pay, and the reports of committees on yards and terminals containing specifications for track scales which were adopted.

Among the important topics discussed, were the use of twisted bars for concrete reinforcement which was strongly opposed, a system of training young engineers in railway service; treatment of timber by creosote processes; the shrinkage of earth fills and the settlement of surface under fills; the loading of telegraph and telephone poles; the conservation of materials and human energy, and the compulsory adoption of the metric system, which was opposed.

H. A. Safford was elected president, and the members attended an annual dinner addressed by several prominent speakers.

May 13-14-15, League of Texas Municipalities.

The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

National Federation of Construction Industries.

The first annual meeting of the federation was held at Hotel Sherman, Chicago, March 24-25 and was notable as the first meeting of a regularly constituted business organization representing the entire construction industry and includes about 200 national associations, which together with the affiliated interests, have a normal annual production of about $3,000,000,000 worth of permanent taxable wealth, including more than one-fourth of the railroad tonnage of the United States. The federation was created in July, 1918, as the result of the request of the war industries board to the chamber of commerce of the United States to organize the construction industries into a single war service committee. In the beginning of 1919, it was decided to reorganize it on a permanent basis.

Among the important subjects considered at the convention were the proposed division of the United States into twelve federal districts, co-terminous with the federal reserve districts, each with an executive committee with a vice-president of the federation serving as chairman and having authority to deal with construction problems locally. Other matters brought up for consideration were freight traffic, standardization in the construction industry, foreign trade, financial operation, industrial relations, jurisdictional awards and Americanization.

In a service letter calling the annual meeting and addressed directly to about 30,000 business men, it was stated that the federation has been formed for the purpose of extending construction and improving conditions in the construction industry. It is intended to co-ordinate the several divisions of the industry. In the accomplishment of these results the objects of the Federation will be:

To promote close coo-perative relations between producers, manufacturers, distributors, contractors, architects, engineers, realtors, financiers and other construction interests; to develop and preserve satisfactory conditions in the relationship of the combined industry to the general public, including the Government, labor and consumers; to serve as an exchange between and common meeting place for associations representing social construction interests;

In cases where a special construction interest is primarily concerned to support the initiative of the representative association in all matters considered by the federation to be within the proper scope of its activities; in cases of common interest to the construction industry in general to take the initiative in investigation, policy, propaganda, legislation, and in such other ways as will benefit the industry; and to provide a united organization which will mobolize the entire strength and experience of the industry.

Immigration Conference.

A national immigration conference will be held April 7th in New York City in the Engineering Societies Building, 29 West 39th street, New York.

National leaders in American industry and finance will discuss the shortage of foreign born labor and the loss of production due to unrest among the workers, and measures will be taken for united action to relieve this condition.

Invitations to attend this conference have been issued by the Inter-racial Council to more than a thousand of the directors of industrial concerns, especially those employing foreign born labor, and to others who are interested in this problem from the standpoint of finance on national welfare including racial leaders. All industrial executives are invited to be present.

Topics to be discussed will include pending bills on immigration, and a constructive policy will be preposed and voted upon.

PERSONALS

Dewey, E. P., has been made city engineer of Pasadena, Cal.

Kellog, R. N., has been appointed highway engineer of Wallowa County, Oregon.

Orbison, R. V., has become city manager of South Pasadena, Cal.

Steebergen, William, has been made road engineer of Jackson County, W. Va.

Keyes, R. D., has been appointed construction engineer in San Diego County, Cal., for the State Highway Commission.

Nelson, C. L., has been elected city engineer of Muskegon, Mich.

Hall, Roy F., has been appointed division engineer of the New York State Highway Commission with headquarters at Watertown.

Shields, J. R., has been appointed special assistant engineer of the public works commission, Sacramento.

Early, J. B., has been appointed resident engineer of Foard County, Texas.

Blum, Weldin & Co. has been appointed consulting engineer to the Comptroller of Alleghany County, Pa.

Logan, Spencer, has been appointed city engineer of Coffeyville, Kans.

Crotty, C. C., has been appointed assistant court director of Houston, Texas.

Heindle, W. L., formerly superintendent of the Wilmington & Philadelphia Traction Co., has opened an office for engineering and contracting at Wilmington, Del.

Solomon, G. R., has been elected vice-president of the Fuller Engineering Corporation, New York.

McComb, D. W., has been appointed division engineer of the Tennessee Highway Department of the United States Bureau of Public Roads.

Lund, A. M., has been elected president of the Little Rock, Arkansas, Engineers' Club.

Barnes, W. T., has become chief engineer of the Spring Brook Water Supply Co., Wilkes-Barre, Pa.

Sheerer, C. E., and Miller, J. H., have formed the Sheerer-Miller Structural Engineering firm in Memphis, Tenn.

Dilling, A. W., has been appointed engineering assistant to the commissioner of public works, Chicago.

Safford, Harry R., assistant to the president of the Chicago, Burlington & Quincy Railroad, has been elected president of the American Railway Engineering Association.

Warren, G. E., has resigned his position as assistant manager Service Bureau of the Universal Portland Cement Co., Chicago, taking effect April 1, 1920, to continue his duties as manager of the American Concrete Pipe Association. Mr. Warren has been with the Service Bureau of the Universal Co. for five years during the last year of which he has also acted as secretary-treasurer of the American Concrete Pipe Association.

Allen, T. H., city commissioner of Memphis, Tenn., has developed a new system of garbage disposal for separating garbage, ashes and rubbish.

Baldwin, Ward, was elected president of the Cincinnati Association of the American Society of Civil Engineers which after two years was resuscitated last month.

Black, Russel V., has been appointed assistant engineer to the City Planning Commission, Akron, Ohio.

Turner, Geo. F., has been appointed city engineer of Youngstown, Ohio.

Lillie, F. M., has been appointed consulting engineer to the city of Youngstown, Ohio.

Percival, F. M., has been appointed engineer of Aransas County, Texas.

Spooner, J. P., Jr., has been appointed engineer in charge of highway maintenance for San Joaquin County, Cal.

Caldwell, W. G., has been appointed highway engineer of Waukesha County, Wis.

Buttes, C. M., has been appointed chief engineer for the $1,800,000 new highway for Butte County, Cal.

Stowitz, G. P., has been appointed chief engineer of the Lord Drydock Co., West New York, N. J.

Freer, F. C., has been appointed county engineer of Douglas County, Oregon.

Ireland, Col. Mark L., of the Motor Transfer Corp., U. S. A., has been appointed a member of the National Research Council Committee on Economic Theory of Highway Improvement.

Boyd, J. C., first vice-president of Westinghouse, Church, Kerr & Co., Inc., will open an engineering office in New York.

Crowe, F. T., recently project manager of the Flat Head Irrigation Project, has become associated with Rich & Markhus, contractors, of Prosser, Washington.

Burgraff, C. L., has been appointed bridge engineer with the Morgan Engineering Co., Memphis.

Johnson, Col. George A., will be the head of the firm of Johnson & Denham and will direct the design, construction, supervision and management of water supply, sewage and other public utilities.

Hamm, R. C., has been appointed engineer of Fort County, Kansas.

Cunningham, Max. L., has been made vice-president and chief engineer of the Municipal Excavator Co., Oklahoma City.

Murray, Joseph A., Jr., has been appointed principal assistant engineer, bureau of engineering, Albany, N. Y.

Ohrt, Fred, has been appointed city engineer of Honolulu, succeeding Wilson, John H., who has been elected mayor of the same city.

Lough, Thomas, has been appointed assistant state engineer, North Dakota Highway Commission.

Prann, C. P., has been appointed city engineer, Meridan, Ct.

Drinkwater, Ernest, has been appointed city engineer of St. Lambert, Canada.

Carman, E. S., president, Cleveland Engineering Society, addressed the Mohawk Valley Engineers' Club at Utica, March 18, on the industrial situation in the United States and Europe.

Brandow, Emory E., has been made bridge engineer for the New York State Highway Department.

Cooke, Charles W., sales manager and assistant general manager of the Acme Road Machinery Co., died at Beaver Falls, Pa., March 2nd.

De Forest, Edgar A., industrial engineer, delivered an address, March 25th to the Brooklyn Engineers' Club reviewing some remarkable developments in the efficient application of power and illustrated a number of new features in the elimination of power losses.

Lee, W. S., vice-president and chief engineer of the Southern Power Co., will also engage in general consulting practice, specializing in hydro-electric work with offices in Charlotte, N. C., and in New York City.

Stimson, Earl, chief engineer of maintenance, Baltimore & Ohio Railroad, and president of the American Railway Engineering Association, stated at the recent Chicago Railroad Convention that the present railroad problems are those of maintenance rather than of construction.

Reeves, Austin H., has opened a consulting engineer's office at Charlotte, N. C.

White, Lieut. Col. R. M., has been appointed superintendent of the Morris & Essex Division of the Delaware, Lackawanna & Western Railroad, with office in Hoboken.

Lane, F. M., has been appointed engineer of the Woodland Diking District, Cowlitz Co., Washington.

Trimble, R. D., with Winston & Co., Richmond, Va., has resigned and has organized the engineering, consulting and constructing firm of R. D. Trimble & Co., Richmond.

New Appliances

A New Bucyrus Shovel

Combines Revolving Shovel, Dragline Excavator, Clamshell Excavator and Locomotive Crane.

The Bucyrus Company's new revolving shovel 30-B, which supersedes 18-B ⅞-yard revolving shovel, has been carefully designed as a universal machine to be used as a revolving shovel, or with the addition of a few extra parts, as a dragline excavator, a clamshell excavator, a locomotive crane, and with a long boom and dipper stick for excavation requiring unusually high lift, in all of which capacities it is available with the minimum of labor, delay and expense, and is designed for 100 per cent efficiency.

When used as a revolving shovel, it carries a 1-yard dipper, having a capacity of 1-yard water measure and 1¼ yards heaped up. It can be mounted on either caterpillar traction, traction wheels or railroad trucks of any gage from 3 feet 3 inches to 5 feet. According to the mounting, the working weight varies from 29½ to 34 tons. It is adapted to the purposes of ordinary contract work including cellar and road excavation, and yet is sufficiently rugged and powerful for operations in clay pits, rock quarries, mining and stripping.

It will operate a 1-yard clamshell bucket on a 35-foot boom or a ¾-yard bucket on a 40-foot boom when provided with additional drum and operating mechanism. These parts, supplemented by a hoisting hook, also enable it to serve as a locomotive crane with a capacity of 9¾ tons at 20 feet radius, with caterpillar traction, and 9 tons on car trucks or tractor wheels.

The equipment for clamshell excavation suffices for dragline operations when supplemented with a suitable drag bucket and line.

For sewer excavation, the machine may be used either with a 30-foot dipper handle adequate for digging a trench 20 feet deep or with a 24-foot handle for a 14-foot trench. The dipper has an unobstructed cutting edge for the corners as well as for the front of the dipper. For exceptionally high lifts, a 26-foot boom and 17-foot dipper handle can be supplied.

The improvements in their design include very rigid construction; accessible steam plant, engines, and machinery; simplified operating lever arrangements; and reduction in the number of working parts.

The caterpillar mounting is strongly recommended to save time and labor, making it possible to move the shovel readily from one job to another without requiring a large force of men. It permits the shovel to back away from blasts without loss of time and to operate in flooded pits where ordinary plant would be idle. With it, the shovel can travel over soft ground and climb steep grades with ease. The caterpillar mounting has no complicated side frames and has eliminated the use of chains in the driving mechanism. The treads are of cast steel with smooth bearing surfaces suitable for travel over city streets, pavements and improved roads without injuring them. The machine can be easily turned in its own length. It is described in Bulletin C-301.

Excavating and Self-Loading Motor Truck

United States patent 1,320,970 was issued November 4, 1919, to E. L. Beaty for a combination of excavating and loading device with a motor truck that provides equipment especially recommended for road building. Pivoted near the center of the truck frame is a horizontal yoke revolving clear of the frame, outside of it, and carrying clear of the front part of the truck, a scraper-like tilting bucket that may be set with the lower side horizontally supported on the surface of the road so that when the truck advances it will be pushed forward and the cutting blades will engage the earth and fill the bucket. The truck driver controls a crank shaft driven by the truck-motor that revolves the yoke so as to carry the filled bucket over the engine and front part of the truck and dump it into the truck body in the rear after which the bucket is returned to excavating position, and so on.

This apparatus is intended to entirely eliminate hand work in light excavation and in loading the spoil.

Any make of truck can be equipped with this power shovel which, on a 3½-ton truck with a 3-yard dump body will, it is claimed, do more and better work than the same truck without the power shovel requiring a force of ten laborers to excavate and load it. With hauls varying from ¼ mile to 2 miles, the use of hand labor for operating the truck involves a loss of from 33 to 75 man-hours per day occasioned by idle time when the men are waiting for the truck to arrive.

An Automatic Discharge Counter

The W. & T. Automatic Discharge Counter sold by Wallace & Tiernan Co., Inc., has been developed to record the application of sewage from dosing chambers to sprinkling filters or contact beds at sewage treatment works. Wherever it is desired to have a record of the number of fillings of a tank this device is applicable, as for water tanks, flush tanks, syphon chambers, chemical solution tanks.

The device consists substantially of an inverted air bell submerged with its bottom just above low level of the syphon tank and provided with a flexible air connection. From the top of the bell is a diaphragm actuating the simple counting and recording mechanism, located at any convenient place.

The Clark Truck Tractor

The Clark truck tractor, designed and built by the Clark Trucktor Co. for contracting service, consists of a 3-wheel steel truck weighing 2,450 pounds and provided with a 25 h. p. four-cylinder engine. It has a speed of ½ mile to 12 miles per hour and an automatic dump body with a capacity of 27 cubic feet of dry or 18 cubic feet wet.

It is very compact with drivers' seat over the engine, and is especially recommended for use in paving, road building and other work where it is found very convenient for hauling buckets of concrete, sand, gravel, earth or other materials.

INDUSTRIAL NEWS

Portland Cement Association.

C. N. Reitze, formerly district engineer of the Seattle office of the Portland Cement Association, has been appointed district manager of the Pacific coast offices of the association at Seattle, Portland, San Francisco and Los Angeles. Since May, 1916, Mr. Reitze has been district engineer in charge of the Seattle office of the association and temporarily will be located in Seattle, although later in San Francisco.

A. P. Denton, formerly district engineer of the Dallas office of the association, assumes charge of the San Francisco office as district engineer.

Charles A. Clark is appointed district engineer of the Dallas office of the association, effective March 15, to succeed A. P. Denton. Mr. Clark has been in the employ of the association since 1917, serving in various capacities in the field and at association headquarters.

H. E. Frech will assume charge of the St. Louis office of the association as district engineer, effective April 1. For two years immediately prior to coming with the association, Mr. Frech was city engineer of Hannibal, Mo.

The Asphalt Association.

Permanent headquarters for The Asphalt Association, an organization representing the producers and users of asphalt for paving purposes, have been established in the new National Association Building, 25 West 43rd street, New York City.

From its main headquarters and its branch offices at Washington, Chicago and Toronto, The Asphalt Association will continue its educational and research work, looking to extension and development of asphaltic types of highway construction along the most effective engineering and economic lines.

J. R. Draney, of the United States Asphalt Refining Company, is president of the association; W. W. McFarland, of the Warner-Quinlan Company, is vice-president; Herbert Spencer, of the Standard Oil Company of New Jersey, is treasurer, and J. E. Pennybacker, formerly chief of management of the United States Bureau of Public Roads, secretary.

The Blaw-Knox Company.

O. O. Olstad, formerly connected with the New York office, has been made manager of the New England territory, with offices in the Little Bldg., Boston, Massachusetts, succeeding A. W. Ransome, who has been appointed manager of the Pacific Coast territory, with offices in the Monadnock Building at San Francisco.

A. W. Ransome, formerly manager of the New England territory, with offices at Boston, Massachusetts, has been transferred to San Francisco in the capacity of manager of the Pacific Coast territory with offices in the Monadnock Building, San Francisco.

Mr. Ransome was born in San Francisco, and is a graduate of the University of California, Class of 1897. He played fullback on the University Eleven for four years, captaining the team of 1896. Immediately after leaving college, Mr. Ransome became engaged in the construction machinery business, until 1917, when he became associated with the Blaw-Knox Company.

Kentucky Rock Asphalt Specifications.

These specifications are issued by the Kentucky Rock Asphalt Co., in order to secure the best results for the public from the use of the asphalt, and the company reserves the right for its engineers or representatives to inspect and advise at any time for the best results.

The specifications are written under several heads including the original construction of crushed limestone, granite or slag, the base course, construction methods and materials, top course, roughened surface, reconstructed pavements, notes on the resurfacing of brick pavements and various clauses concerning city pavements, railway tracks, gutters, manholes, shoulders and crowns.

Engineering Company Incorporates.

The Haddow Engineering Co., of Tacoma, recently filed articles of incorporation, naming a capitalization of $25,000. Incorporators are: Robt. Haddow, Jr., Bert Hall, et al. The concern will do a general engineering and contracting business.

Waterworks and Sewage Disposal.

J. W. Frazier, J. W. Ellms and R. E. Sheal announce the incorporation of The Frazier-Ellms Sheal Company for the purpose of conducting a general engineering business in the design and construction of waterworks, pumping and power plants, water purification and sewage disposal plants, sewer and drainage systems and buildings. The company is also prepared to conduct engineering investigations, prepare reports and make appraisals.

The active members of the company have been engaged for many years in consulting engineering work, but along the lines of their individual specialties. By combining their varied experience and special training, they are able to offer highly trained technical service in a wide field.

The offices of the company are in the Illuminating Building, Cleveland, Ohio.

The Road to Camp Knox.

A handsome pamphlet describes the production and preparation of Kentucky rock asphalt and its use in road building. Another little booklet, entitled "The Road That Carries the Load," gives further information on the same subject and is also published by the Kentucky Rock Asphalt Co.

The Concrete Dope Book.

This booklet, issued in the interest of the Winard Model concrete hoists and Winard water tanks and pumps, gives specifications and illustrations supplemented by an equal number of pages of interesting data concerning ordinary concrete construction, such, for instance, as materials and proportions required for 100 square feet of concrete sidewalks, floors, or plaster work; notes on making and setting foundation forms; prices of various concrete constructions, concrete blocks, and other information.

The Barber-Greene Company.

This company is now represented in St. Louis by R. E. Foulke, 404 3rd National Bank Bldg.; Pittsburgh by J. A. Gurney, 605-606 Arrott Bldg.; Philadelphia by F. S. Sawyer, 1010 Penn Square Bldg., and Indianapolis by W. T. MacDonald, 305 Merchants Bank Bldg.

These are direct Barber-Greene branches and the representatives experienced engineers, well qualified to furnish true service and engineering advice to all individuals and firms having material handling problems, especially those involving the installation of Barber-Greene Self-Feeding Bucket Loaders, and Barber-Greene Standardized Belt Conveyors.

T. L. Smith Opens Eastern Offices.

The establishment of a T. L. Smith Company New York office and warehouse has been long contemplated and is an important item in the general expansion of the Smith organization.

E. R. Marker has taken over this New York office's big showroom space on the ground floor of the Hudson Terminal Building at 50 Church street. Shipments of all sizes of mixers, pavers, pumps, as well as all repair parts will be made directly from the Eastern Warehouse, located at 122 Lilly street, Newark, N. J. Mr. Marker for four years had charge of the Milwaukee district office and for the following three was sales manager, operating through the Milwaukee office. Under his direction the sales of the company have increased over 150 per cent.

Combination of Two Large Engineering and Construction Companies.

The combination is announced of the organizations of Westinghouse, Church, Kerr & Co., Inc., Engineers and Constructors, New York, and Dwight P. Robinson & Co., Inc., constructing and consulting engineers, of New York.

The new company will be called Dwight P. Robinson and Company, Inc., and will occupy executive offices at 61 Broadway and engineering and designing offices in the Grand Central Palace, 125 East 46th street, New York.

Dwight P. Robinson—president of the new company—was for many years president of the Stone & Webster Engineering Corporation, and in 1918 formed his own company.

PUBLIC WORKS.

CITY COUNTY STATE

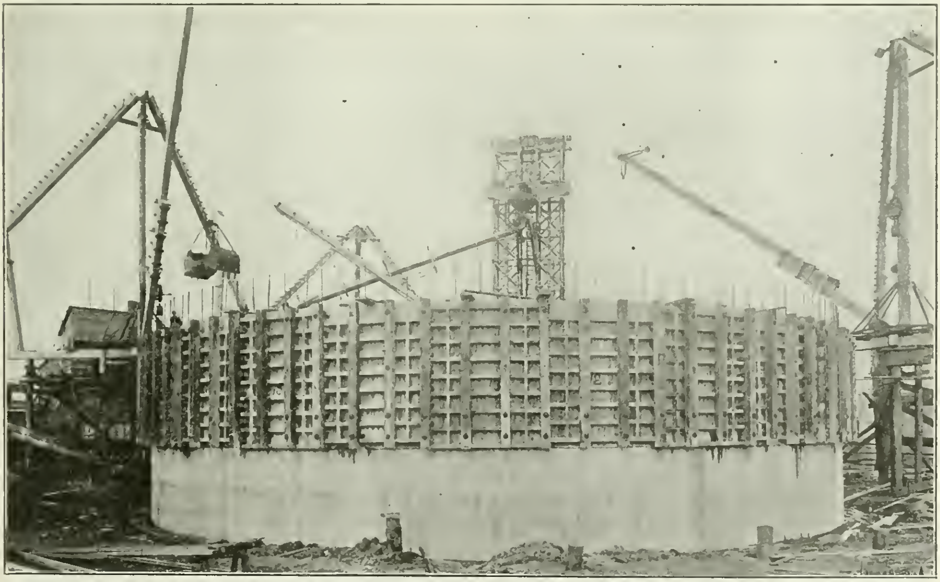
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, APRIL 10, 1920 No. 13

Bridgeport Sewage Disposal*

An intercepting system collects the discharge from 59 sewers previously emptying into tidal creeks and the harbor. The sewage will be delivered to a well below tide level, at the bottom of which it will be screened, the solid matter delivered by a pneumatic conveyor system to a storage hopper elevated above the street that discharges into tank wagons in which it will be hauled to the town farms and buried. The liquid effluence will be pumped to the force main by a battery of centrifugal pumps with an ultimate capacity to handle the sewage from a population of 180,000, or a total dry weather flow of 35,000,000 gallons daily.

Previous to 1906, the city of Bridgeport, Conn., was served by a combined system of sewers, many of them too small, and all emptying into the nearest tide water, where they had 59 outlets in the Pequonnock river, which divides the city into the eastern and western sewage districts and into several creeks and a pond. Large areas of the city near Long Island Sound have such a low elevation that it is



EXTERIOR OF CAISSON WHILE BEING CONSTRUCTED AND SUNK. FORMS AND REINFORCEMENT IN POSITION FOR INTERMEDIATE COURSE.

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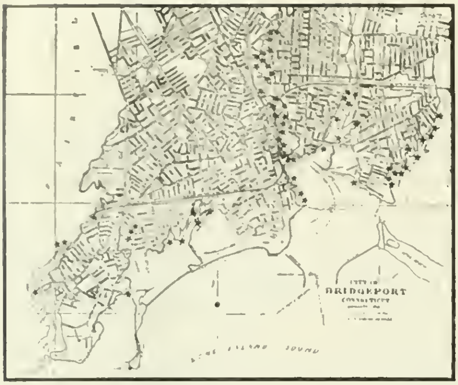
* Abstract of paper presented to the Connecticut Society of Civil Engineers, by James A. McElroy, city engineer, Bridgeport.



OUTLETS OF OLD SEWERS—SHOWN BY STARS.

impossible to collect the sewage and deliver it to outfalls or disposal works without pumping.

Thorough investigations were made by specialists who recommended two separate intercepting systems and pumping stations for a deep water outlet. In 1916, after the intercepting system had been completed as far as it would operate by gravity, the plans were reviewed, additional investigation made, and the original plans confirmed except that Imhoff tank treatment was recommended.

The Imhoff treatment in other cities was accordingly investigated and was found to be so uncertain and unsatisfactory, that it was rejected, and ultimately it was decided to dispose of the sewage by dilution preceded by clarification by fine screens, opportunities being provided for the future extension of the outfalls to permit of aditional treatment if necessary.

This plan was adopted in accordance with the report of a committee consisting of the city engineer, the director of public works, the president of the paving and sewer commission, and the chairman of the committee on sewers of the common council. Their reports were approved by George W. Fuller and George A. Johnson and new plans were prepared for the western district pumping station including screening and pumping equipment to take care of the present sewage of the district with provision for the installation of an additional equipment when required in the future.

DISPOSAL WORKS.

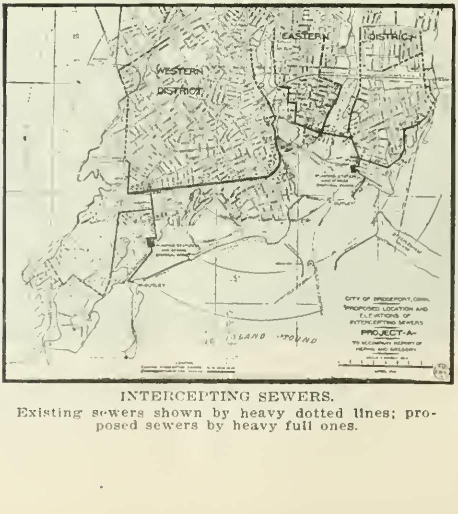
Early in 1919, work was commenced on the combined treatment plant and pumping station for the western sewage district at the foot of Bostwick avenue on the water front, where there has been built an 84 x 66-foot rectangular one-story building over the concrete pump well 80 feet in inside diameter and 45 feet deep, which contains the screens, pumps, motors, grit basins, air compressor, pneumatic conveyor, and other elements of the installation. The plant which is designed for an ultimate capacity of 35,000,000 gallons per day at a future time when the ultimate population of the district may become 180,000, will be equipped at first for the treatment of about two-thirds of this amount of sewage for a present population of 100,000; provisions being made for increasing the screening capacity 50 per cent when necessary.

A special feature of the design is the arrangement of pumps and screens so that the solid matter is removed at the foot of the deep well in the pump house, leaving only the liquid effluent to be lifted by the pumps. This arrangement was made to secure greater efficiency of the screens although the cost was somewhat greater than if the screens had been located at high level.

The flow line of the interceptor at the plant is 22 feet below the street level and 10 feet below mean low water. The sewage flows through a sluice gate and a bar screen and thence through a concrete channel to the R-W screen, the effluent thence passing over an adjustable weir to the sump whence it is pumped 25 feet to the force main by two 20-inch horizontal centrifugal pumps each with a capacity of 15,000,000 gallons per day, and two 15-inch horizontal centrifugal pumps with capacities of 8,000,000 gallons per day. The pumps will be direct connected to electric motors automatically controlled by floats in the sump.

The two screens at present installed have circular disks 22 feet in diameter, inclined at an angle 15 degrees to the horizontal and on them a concentrically mounted truncated cone 12 feet in diameter at the base. The surface of both disks and cone consists of a number of removable bronze plates perforated and set at such an elevation that about one-third of the disk is above the surface of the water. The screens revolve at a speed of about one revolution in two minutes and the solids retained on them are removed by revolving radial brushes that deliver them to the hopper of the pneumatic conveyor system that delivers to a storage tank 10 feet above street level, thus permitting the screenings to be dropped into tank wagons, carted to the town farm, and buried.

The sewage is measured by a venturi meter with automatic recording chart and register electrically operated. The building will contain a complete system of heating, ventilating and plumbing, including toilet and shower bath.



INTERCEPTING SEWERS.
Existing sewers shown by heavy dotted lines; proposed sewers by heavy full ones.

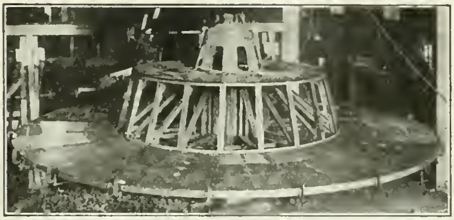
CONSTRUCTION OF PUMP WELL.

The reinforced concrete lining of the pump well is a thick cylindrical wall 80 feet in inside diameter and 45 feet deep that was built in successive 10-foot sections and, contrary to the predictions of engineers who believed it impossible to overcome the skin-friction, was readily sunk by interior excavation without even requiring additional loading.

The lowest ring, containing 475 yards of 1:2:4 concrete and 30 tons of reinforcement steel, had the interior surface flared outward to a cutting edge at the bottom, and was concreted in wooden forms with the interior and exterior walls connected by sectional horizontal tie rods spliced with sleeve nuts. The circular twisted steel reinforcement bars were wired to vertical and inclined twisted steel bars and were overlapped and wired together at splices.

After the first ring was stripped, it was sunk until the top was about one foot above the ground level, when the forms were reassembled on it and the second ring concreted, seasoned, sunk, and so on for the successive rings each of which contained 500 yards of concrete and 16 tons of steel, all being concreted in continuous 8-hour operations. The rings were commenced in March and finished June 1st.

The concrete was mixed in two 1-yard mixers located at the foot of a wooden tower in which the concrete was hoisted to a steel receiving hopper and thence spouted to the forms. The gravel and sand bins above the mixers were filled by a clamshell bucket operated by a stiffleg derrick.

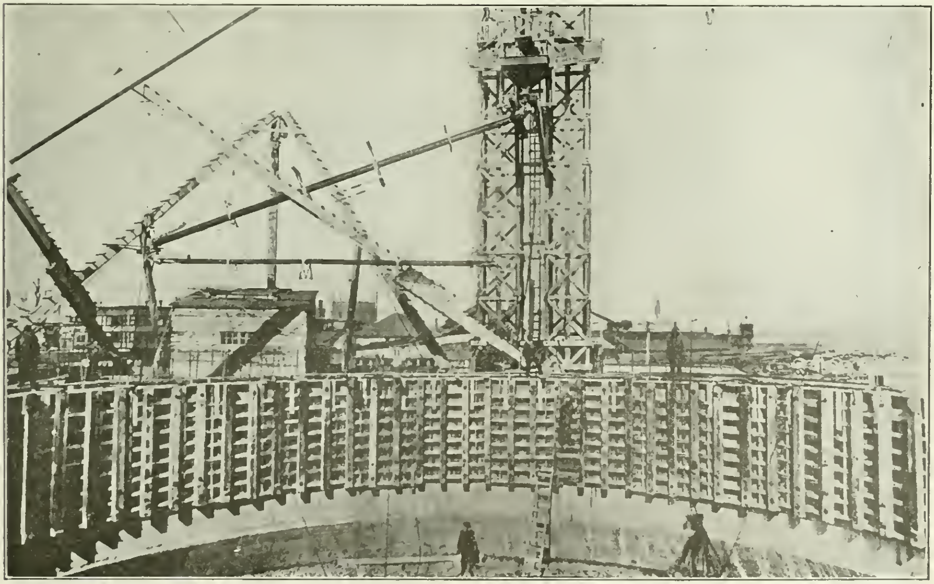


BRIDGEPORT SCREEN BEING ASSEMBLED.
Shows framework of "hat," etc.

The earth inside the well was excavated at the rate of 200 yards per day by two ¾-yard clamshell buckets operated by two 65-foot boom stiffleg derricks on opposite sides of the caisson.

As the caisson descended, frequent levels were taken and whenever it dropped out of plumb, excavation on the low side was temporarily discontinued while it was maintained on the high side until the caisson righted itself, never getting more than 9 inches out of level. Although it was not at first intended to keep the caisson dry during excavation, the amount of water entering it was found to be so small that it could easily be controlled and was therefore handled with pumps that kept the bottom dry at all times.

The caisson was sunk so easily that an attempt was made to excavate the last 3 feet of the depth below the cutting edge without sinking the caisson, but it resulted in pumping so much sand that the derricks and concrete tower were undermined. The top ring was then added to the caisson and the the latter was allowed to fill with water and the remaining excavation was excavated under water until the caisson had sunk to the required depth.



INTERIOR VIEW OF CAISSON, SHOWING LOWER TWO COURSES. SPOUTING CONCRETE FROM HOISTING TOWER TO FORMS.

PUMP INSTALLED ON MOVABLE PLATFORM BOLTED TO WALL.

Soundings showed that the excavation was sufficient, and the bottom was covered with 1,800 yards of concrete placed under water in one continuous operation lasting 39 hours, the men being occasionally allowed to stop for refreshments but the mixers being kept in operation continuously, except when shut down for minor repairs. There was a 2-hour delay on the first day and the plant was shut down about 5 hours at different times during the second day.

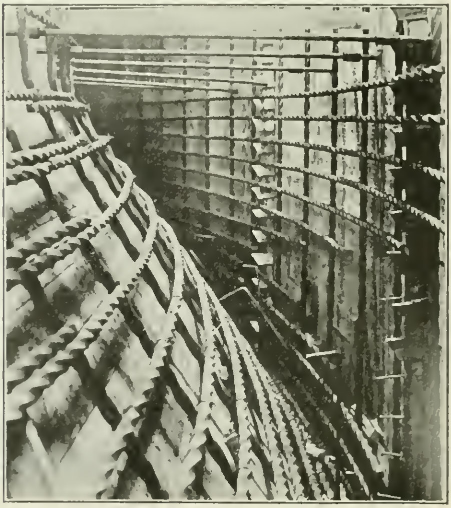
After the bottom concrete had hardened for 3 weeks, the water was pumped out and as no leaks were found, the floor was finished and work commenced on the forms for the inside wall and partitions. It is expected *that the plant will be put in* operation about August 1st. The reports of the engineers and committees that investigated the problem and recommended its solution and a general description of the plant, with plans of the pump well and equipment were prepared by City Engineer James A. McElroy and published in the *Municipal Journal and Public Works* of May 24th and October 11th, 1919, pages 363 and 225, respectively, to which reference may be had for additional data.

The locations, mentioned in the beginning of the article, of the 59 sewer outlets that originally polluted the rivers, creeks and harbor with sewage that is now treated at the disposal works are indicated on the accompanying map by stars that show how fully they covered the lower portions of the river and creek channels, insuring an increasing nuisance. The intercepting sewers that eliminated them are shown by heavy black lines on another map that also shows the division of the city and of the sewage system into eastern and western district with the locations of their respective independent pumping stations and sewage disposal works. The intercepting sewers are from 24 to 66 inches in diameter and discharge to the pumping station through 66 and 72-inch mains with 48 and 60-inch outfalls to outlets in deep water where the effluent will be immediately diluted and carried away without, it is expected, causing any nuisance.

FORMS.

Both inside and outside forms for the circular wall of the pump well were made in wooden panels about 6 feet wide and 10 feet high with vertical lagging nailed to horizontal scarf boards about 2 feet apart in the clear made of pairs of boards with the inner face cut to the required curve and separated by vertical spacers. They were held in place by adjustable horizontal tie bolts screwed up against temporary radial spacing pieces. The ends passed through 6 x 6-inch vertical bearing pieces about 3 feet apart, every third piece engaging the ends of the scarf boards of two adjacent panels which overlapped each other, allowing the edges of the lagging to make a close butt joint under the vertical piece.

The forms for the first course of the wall were braced at every panel by pairs of inclined struts bolted to vertical piles driven in the ground. When the forms were stripped, both ends of the horizontal tension bolts were screwed out of the sleeve nuts and removed, leaving the main body of the bar permanently embedded in the concrete and permitting the forms to be readily detached. The forms were lifted vertically until the lower row of bolt holes engaged the upper row of bolt holes in the top of the concreted section of the wall and were connected to the permanent bolts in them, forming anchorages for the cantilever verticals that were bolted together with two tiers of bolts above the



INTERIOR OF FORM, SHOWING REINFORCEMENT STEEL FOR CUTTING EDGE OF CAISSON.

top of the concreted ring, thus easily providing for the support and adjustment of the forms.

Both concrete mixers were installed at the bottom of a duplex wooden hoisting tower with an elevator bucket operated in each side that discharged the concrete into a large hopper with a gate through which it was delivered to long trussed sections of steel chutes connected with a swivel joint supported from a derrick boom and enabling the chute to command all parts of the wall.

The wooden derricks that handled the excavating buckets, sand, gravel, forms and other plant and materials were equipped with spliced booms 65 feet long, were swung by bull wheels, and were installed on pile towers about 20 feet high, located close to the circumference of the wall so as to enable the boom to be operated flat and clear the tops of the forms.

Advantage was taken of the horizontal form rods embedded in the concrete wall to provide support for bracket platforms on which the steam pumps were installed for unwatering the caisson. These brackets had a timber framework with top and bottom horizontal sills provided with short bolts that were inserted in the holes in the wall and screwed into the sleeve nuts that were left there when the forms were stripped, thus giving very convenient and positive attachments that held the pumps securely without swinging or displacement. After the caisson was bottomed, the bolt holes on the inner surface of the wall were pointed with cement mortar.

Municipal Engineer's Records and Reports *

By H. F. Blomquist †

These records contain items which are necessary for informing the taxpayers what they have obtained or are to obtain for the money spent. Reports should omit details unessential to a general knowledge of the subject. Special reports should be given careful attention and be technically exact.

Nearly all of the construction and maintenance of the larger municipalities is done directly under its engineering department. The amount of money expended for such work is often the greater part of the revenue collected by such municipalities. The accounting and record keeping connected with this work is therefore of very great importance and merits much more consideration than is sometimes accorded it. It is not the purpose of this paper, however, to outline any definite system or scheme for such records, because any such attempt would be of little value since the organization and method of operation differs very largely even in municipalities of approximately the same size.

Also the work and organization of the engineering department of a large city is of necessity different from that of a small one. If a standard system of records were to be proposed, it would be necessary to include provisions for the activities of the largest unit of the particular division of the work and organization. While such a system might be very satisfactory for one organization, it would be far too elaborate for the greater number of municipalities and therefore not at all applicable to the average municipal engineers' organization. One of the purposes of any record is to furnish information regarding the operation, progress or results obtained from any particular activity, and in order to accomplish this, the form of records must be designed to meet the conditions peculiar to that particular activity, and in the simplest way that will give the information desired.

Municipal engineering consists of such a variety of work, and is done in so many ways that no complete classification of it can be made. Small cities most commonly suffer from a lack of co-ordination of the work done. Where it is not done with some definite plan in view for future extension of the same so as to make a complete whole, much work is often wasted later in changing and rebuilding. This is largely due to lack of systematic records and plans at the beginning. A large part of engineering work is purely research, and the value of such work is only preserved by the records and reports made of the same.

Among the values and purposes of records may be submitted the following: Historical; guide for future operations; basis for estimates; provide facilities for carrying on work; show efficiency of equipment, method or administration.

It is the intent of this paper to call attention to some general principles that affect the value of engineering records, and reports, and present a few suggestions on record keeping.

COST RECORDS.

Engineering records must of necessity include two separate elements of the enterprise, namely, the financial, or cost, and the material or results obtained. While the strictly accounting division of a municipal government must account for all revenues received, and assume the responsibility of collecting the same, also show in detail all disbursements and financial balances which give the status of the different departments of such municipality, it does not show the results obtained from certain expenditures, or in other words, the value received, and if such results are to be presented to the average citizen at all, or even to the executive officers of a municipal government, they must come from the engineer's records. If the voters are to obtain information as to what they will get for a certain bond issue, say, for water works improvements, or other municipal activities, they must get the same from the engineer's report. If anyone wants to find what it would cost to have the street paved in front of his premises, it must come from the engineer's office. If someone wishes to know the efficiency and general results obtained by the use of certain kinds of machinery or equipment, or method of operation as compared to that obtained from some other kind in municipal activity, the engineer must be able to furnish it, and so on. The accounting division of a municipality is not expected to give all this information, because much of it requires research work and technical calculations that must be done by engineers, but if accounts were kept with the purpose in view of furnishing all possible data for such information in addition to the balance sheet and other financial statements, the work of keeping the first element of engineering records, namely, cost accounts, would be greatly reduced.

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* Paper before the Minnesota Surveyors' and Engineers' Society.

† Prin. Asst. Engineer, St. Paul Water Dept.

While good financial accounting is an absolute necessity for municipal government, yet the engineering accounting or record keeping is of more interest, and of especial value to a muncipality. The common financial statement does not often interest the average citizen, except in so far as it shows the amount of taxes he will have to pay the coming year.

I do not believe it is desirable, however, that the financial accounting should be changed so as to include all the engineers cost keeping, but it should be so modified or changed as to furnish certain information which is valuable and necessary for such cost accounting. Where the engineer's organization is not able to keep a complete system of cost accounts, a little additional work of the accountant would make it possible to so divide charges against improvements as to show at all times the cost of separate jobs of municipal work, also of separate items of the same job, and what part is permanent improvement or assets, and what part is maintenance or other charges. This can be simplified by attaching a blank distribution slip to all vouchers and pay rolls passed for payment, on which is marked the proper charges to be made. The engineer would make the distribution on these blanks when the nature of the work and proper method of distribution is not known to the accounting division. The extent to which such distribution is desirable will depend upon the organization of both the financial and engineering departments of the municipality.

In the smaller cities the city engineer's position may often be compared to that of the general superintendent of a corporation, and because of his acquaintance with the municipal business he can be of great help in outlining a proper system of accounting for the municipality. The accounting should in all cases be so complete as to furnish all desirable financial details of the material progress of a city's activities, as well as the mere balance sheet feature. In this connection, as well as in many others, the engineer has not assumed the position he should logically hold in the administrative division of an enterprise.

ANNUAL REPORTS

General municipal engineering reports are most commonly issued annually and should contain the results of the work for the period covered, together with other information of historical value, and for general information. Such reports prepared so as to form a link in a chain of records of the municipal work will became a history of the municipality's material progress, and are very valuable as such. The writer has found old annual reports of very great value many times in solving the problems of the city engineer's office, and in many instances they were the only source from which certain information could be obtained.

In order that the report may be of the most value, it should be very carefully prepared. It must, of course, consist largely of a summary of items from the records of the construction and improvement work done, but these can be presented in such manner as to give an interesting account of the material progress of the city together with frank statements of the existing conditions of the public property and utilities that come within the care of the engineering department, also suggestions as to desirable changes or improvements of the same.

A common weakness in reports is to detail unimportant things, and leave out the conclusions or results obtained and other important things. It is not important how much the street department paid to Tom Jones or Sam Smith in pay rolls during the past year, but it is important how much of the pay roll was spent for cleaning streets, paved and unpaved, and how much street cleaning cost per square yard, how much was spent for street sprinkling, how much for permanent work, such as building culverts, sidewalks, pavements, etc. Almost every good thing can be overdone, and reports are not to be excepted.

In making reports its purpose as well as the viewpoint of those to whom it is to be made should be kept in view. Too much detail work included in a report confuses the reader and often prevents him from grasping the valuable part of it. For example, it would be undesirable to include in the published annual report all the readings and detail description of a test for the efficiency of a steam or electrical pumping plant, or of measurements and data taken for determining the strength and condition of a bridge, but it is important to give a general description of such test or examination, and a clear statement of the results obtained. The detailed description and data connected with such work should be carefully included in a special report for the office files, and other necessary requirements.

SPECIAL REPORTS.

Much of the city work requires special reports, which cover for the most part purely research work.

Under such come estimates of costs, valuation, investigations of water supplies, type of systems or machinery, to be adapted for municipal utilities, tests of machinery and apparatus, and many others. All such special reports serve an entirely different purpose from the ordinary annual report or progess report, and should include in detail the measurements, observations, source of information and methods used in arriving at the conclusions. When such reports are completely worked out and include the information necessary to solve the problem at hand, other experts can easily review the same and the conclusions verified or proven incorrect with very little additional work.

The value of an engineer is often reflected in these special reports and here is where he has an opportunity to convince those connected with the problem that he holds the most important position connected with the proposed project.

INDEXING DATA.

The indexing of data is one of the most important factors in record keeping. A very valuable paper on this subject was presented by Mr. McKellip at a former meeting of this society. I have, therefore, not included it in this paper, but wish to state very emphatically that good record keeping is of little practical value unless a good and complete indexing system is kept of the same.

COST DATA.

Cost keeping may often be considered as a factor in the other forms of construction or progress records, whose purpose is to show the cost of the various items that enter into a particular job or structure. It deals both with materials and labor, and unless a simple and yet complete system is employed for gathering the required data, cost keeping may become very cumbersome. With a simple system regularly kept up, cost accounting may be done without confusion, but a lack of system will invariably result in an unreliable record, although it is often the result of much tedious work. Some instances have come to my observation where cost data is carried in minute detail beyond its practical value. The degree to which cost data should be carried will depend upon the demand and the practical value derived from it. Cost data furnishes valuable information for estimates in new work, and valuation of old work or utilities, and for analyzing methods of operation, and determining which are costly or economical to use. It should be left to the discretion of the engineer, after he considers the purpose and value of a particular cost account, to what extent the account should be subdivided.

STANDARDIZING FORMS FOR RECORDS.

Although municipal engineering work is carried on under different forms of organizations and the records are kept in different manner among the American cities, yet there are certain statistics and records that are common to all. I believe it would be desirable to have a committee work out a form of statistical report and when it has been put in the best practical form and approved, ask all municipal engineers to use the same as a part of their reports. Valuable comparisons could then be made among various cities. Such report should contain data on all common features of the engineering work, such as amount of various kinds of pavements used in the city, amount laid during current year, average cost of each kind; number of miles of streets of each kind of street surface, cleaning and maintenance cost per unit of each; similar data on sewers and water works. Nearly all reports contain this information in one form or another, and a uniform method of reporting the same would be very desirable.

Triple Expansion vs. Centrifugal Pumps

The following letter was received a few days ago and submitted to Mr. Day for such comment as he might wish to make. He promptly replied, admitting the error in the calculation which Mr. Gibson points out. Mr. Gibson's letter is as follows:

Editor, Public Works, New York City.

Dear Sir:

The calculations by L. A. Day in your issue of January 24, comparing the respective costs of pumping in water-works service by triple expansion flywheel pumps, and steam-turbine-driven centrifugal pumps are of interest because of the presumably authoritative data therein presented regarding first costs, load factors, duties and operating expenses. The data appear, however, to lead to a conclusion quite contrary to that stated. That is, instead of the total cost per year of the triple pumps being lower than that of the centrifugal pumps of equal capacity, the centrifugal units have the best of it by a good margin at all points save one, namely, that for the 40,000,000 gal. per day unit with steam at the high price of fifty cents per thousand pounds, where the total charges for the two types of units come out nearly the same.

Mr. Day's error follows from a wrong method of calculating the fixed charges from the useful lives and first costs assumed for each of the two types of pumps respectively. Before proceeding to point out this error, the somewhat partial character of two of the assumptions upon which his calculations are based should be mentioned.

Mr. Day assumes that the reciprocating pump will last thirty-five years, and the centrifugal unit only twenty years, although the reason for this difference is not obvious, since the steam turbine-driven centrifugal pump is more simple and has fewer parts subject to wear than has the reciprocating pump, with its numerous water valves, steam valve gear, packings, plungers, pistons, cylinders, bearings, etc. He quotes a report of the Committee on Depreciation of the American Water Works Association, but the data used by that committee in reaching its conclusions were apparently so unsatisfactory that they have never been disclosed, and they should not, therefore, be given too much weight.

Mr. Day sets down the cost of foundations for a reciprocating triple expansion engine at $1,000, as against $3,000 for a turbine-driven centrifugal pump. This element of cost is extremely variable, according to individual conditions, but it certainly must be an exceptional case where the centrifugal unit, weighing one-twelfth or one-fifteenth as much as the reciprocating unit, and occupying only about one-tenth as much cubical space, requires foundations costing three times as much as for the latter.

Differences of opinion as to probable life and cost of foundations may, however, be left aside in view of the remarkable miscomputation introduced in the calculation of the fixed charge for the centrifugal unit. Take, for example, the 20,000,000 gal. units. The first cost of the triple of this size is $261,000, and the fixed charges are taken as 1.36 per cent for annuity, as required for an assumed life of thirty-five years, and 5 per cent for interest, or a total of 6.36 per cent, so that the annual fixed charge is $16,600.

In calculating the annual fixed charge on the centrifugal unit, however, a new idea is introduced. As above mentioned, it is assumed that the centrifugal will last only twenty years, as against thirty-five years for the triple, and this is taken as a warrant for multiplying the $70,000 cost of the centrifugal by the ratio of 35 to 20, or 1.75, to obtain an amount to which is added the $3,000 for foundations, to make a total of $126,000 upon which 3.36 per cent for annuity and 5 per cent for interest, or 8.36 per cent altogether, is levied, giving a total annual fixed charge of $10,550.

Now a sinking fund is presumably to provide for replacement. According to the assumption, the centrifugal unit is worn out at the end of twenty years, but this annuity will by that time have accumulated to $70,000, so that the new pump can be bought to replace it, just as at the end of thirty-five years the reciprocating unit will be worn out, but can be replaced from its sinking fund.

To put this in another way, at the end of thirty-five years we would have a worn-out triple engine and $261,000 in the bank, while for the centrifugal we would, according to Mr. Day's method, have one worn-out unit, one three-quarters worn out, and an accumulation, due to the investment of 3.36 per cent of $70,000 annually over a period of thirty-five years, of approximately $323,000, assuming the annuity to be invested at 4 per cent, compound interest, as apparently assumed by Mr. Day, although not so stated in the article. In arriving at the $323,000, it is also assumed that $70,000 was not drawn from the sinking fund when the second centrifugal pump was purchased. If, however, this amount was drawn from the sinking fund at that time, why is it necessary to multiply $70,000 by 1.75 in obtaining the amount upon which annual charges are figured for the centrifugal pump?

Again, the annual fixed charges of 8.36 per cent made by Mr. Day against the centrifugal unit, consist, as already mentioned, of 3.36 per cent for sinking fund and 5 per cent for interest. Mr. Day first multiplies $70,000 by 1.75, then adds the $3,000 for foundation, and then multiplies the sum $126,000 by 8.36 per cent to obtain the annual fixed charge of $10,500. What right has he to charge 5 per cent interest on three-quarters of the cost for the second pump all through the twenty years before that pump is actually purchased?

It really comes down to this: Accepting the life of twenty years for the centrifugal pump, the amount upon which the annual charge of 8.36 per cent is to be made is just $70,000, or the cost of the unit. The annual charge to be made against the $3,000 for foundations depends upon how long they are supposed to last. Mr. Day assumes, apparently, that they will last thirty-five years. If so, the annual charge for sinking fund against the foundations should be only 1.36 per cent, with 5 per cent for interest. Neglecting this point, however, and assuming $73,000 is the amount which will have to be invested when a new pump is required, Mr. Day's table of fixed charges should read as follows:

FIRST COSTS.

	Triple	Centrifugal
20 m.g.d	$261,000	$73,000
30 m.g.d.	292,000	85,000
40 m.g.d.	306,000	103,000

ANNUAL FIXED CHARGES.

	Triple	Centrifugal 20 Yr. Life	Centrifugal 35 Yr. Life
20 m.g.d.	$16,600	$6,100	$4,650
30 m.g.d.	18,600	7,100	5,400
40 m.g.d.	19,500	8,630	6,550

The last column, based on the assumption that the centrifugal pump will last as long as the triple—that is, for thirty-five years—has been added. Summarizing, we have the following total costs, using the costs for steam, repairs and maintenance as given in Mr. Day's calculations:

SUMMARY.

	50 Ct. Steam	30 Ct. Steam
20 m.g.d.		
Triple	$38,100	$29,800
Centrifugal 20 yr.	35,150	23,650
Centrifugal 35 yr.	33,700	22,200
30 m.g.d.		
Triple	50,000	37,800
Centrifugal 20 yr.	49,000	32,400
Centrifugal 35 yr.	47,300	30,700
40 m.g.d.		
Triple	59,800	44,000
Centrifugal 20 yr.	60,380	39,780
Centrifugal 35 yr.	58,300	37,700

Very truly yours,
GEORGE H. GIBSON.

Rahway River Drawbridge Moved

400-ton structure lifted 32 inches by hydraulic jacks, placed on 50-ton trucks on falsework tracks and hauled 50 feet by tackles and hoisting engines and a crew of 50 men.

The reconstruction of a bridge across the Rahway river on the Perth Amboy branch of the Central Railway of New Jersey at a point about 1½ miles from Rahway required traffic to be by-passed which was accomplished by shifting the old double track drawbridge about 50 feet transversely where it was installed on a temporary wooden pier and connected with the main line tracks at both ends of the old structure.

The old drawbridge, weighing about 400 tons, was a plate girder structure with a span of 146 feet and a girder depth of 8 feet. It was shifted from old to new position, Sunday, Oct. 26, by a total crew of about 50 men, under direction of J. J. Yates, principal assistant engineer.

Although the bridge was over a stream where the tide rises and falls several feet, it was not practicable to lift and lower and transport it by water because the depth of the river is so shallow at the site that portions of the bottom under the bridge are exposed at low tide and pontoons could not be used without excessive cost for dredging. It was therefore shifted to new position by rolling transversely, a method which took longer and cost as much or more than floating would have done had it been available.

Four lines of trestle falsework were constructed from the old to the new position of the bridge, making an angle of about 80 degrees with the axis of the bridge, and on each of them were installed, one under each truss, two standard 50-ton car trucks connected by a long 12 x 16-inch timber reach.

The pivot, turntable wheels, and other center pier apparatus were securely attached to the bridge floor or trusses and the bridge was lifted about 32 inches by four 100-ton Watson-Stillman hydraulic jacks installed on the pivot pier, and by two 60-ton jacks on the abutment at each end.

The pivot pier jacks were located inside the drum where there was very little clearance with the radial struts and other members so that they were operated at great disadvantage. Although they had a nominal 12-inch stroke, it was found impossible to average more than about 6 inches lift for each setting of the jacks and the blocking, shifting and operation were so difficult that it required 3 hours to lift the span to a height of 32 inches, permitting the trucks to be moved under the trusses which were lowered to bearing on them.

The bridge was then moved forward to a position over the new pier by means of two four-part tackles operated by the hoisting engines on two floating pile drivers and by men with pinch bars which as the event showed would have been handled without the use of the tackles. Only about 5 minutes was required for the actual movement of the span to a position within 2 inches of the required center location of the pivot that was lowered to engage the old fashioned base plate with a clearance of ¼ inch or less but was not provided with any pilot or guiding devices. It was therefore found necessary to lower the bridge almost to the required position, raise it, shift it, lower it again and so on until at last the pivot engaged the bed plate after about 3 hours' effort.

The experience gained in this work demonstrates that considerable time was lost on account of the unfavorable position of the pivot pier jacks inside the turntable. It was therefore decided on future occasions when similar operations were to be undertaken that it would be better policy to incur the additional expense of providing seats for the four pivot pier jacks outside the turntable and thus allow them to be operated with much greater rapidity and efficiency which will, it is expected, enable a similar bridge to be shifted and traffic resumed within a period of 3 hours.

Resurfacing Pavements in Several Cities

During the year 1919 the city of Lawrence, Mass., removed 6,110 square yards of sheet asphalt that had seen about twenty years' service, and replaced it with "Warrenite." After removing the old asphalt, some repairs were made to the concrete base, bituminous binder was laid, followed by the Warrenite surface. Granite blocks were laid as stretchers along each side of each rail of the street railway. These blocks were furnished by the city and delivered on the work without cost to the contractor.

The contract prices for this work were: Removing old asphalt and cleaning concrete base, 30 cents per square yard. Extra concrete for repairing base, $9.95 per cubic yard. Bituminous binder laid in place, $7.60 per net ton. Wearing surface laid in place, $1.93 per square yard. Laying granite blocks as stretchers, $1.93 per square yard.

Some old wood block pavement in Indianola, Ind., which had been carrying business traffic for seven years was resurfaced last year by sweeping clean and applying tarvia B (warm but not hot) and covering this with a heavy layer of sand. This work was done by the regular city gang under the supervision of A. H. Gilliland, city engineer.

Bids were asked last year by North Tonawanda, N. Y., for resurfacing water-bound macadam with tar macadam, using slag, crushed stone screenings and tarvia. As the bids ran about $11,000, the city decided to do the work with its own forces, and completed it at a total cost of less than $5,000.

The old surface was thoroughly scarified; crusher run slag was used for the bottom 4 inches and graded slag for a second course 2½ inches thick and screenings for a binder. Tarvia was applied to the surface at the rate of ¾ gallon per square yard and covered with screenings. Another application of Tarvia was made at the rate of ⅛ gallon per square yard and this also covered with screenings.

Parking Automobiles in Palatka

Most of the smaller cities in Florida find that the construction of good roads during the past five years or so has so increased the use of automobiles, both those owned by the residents of the state and those belonging to tourists, that the problem of parking automobiles in the streets of the city has become a very serious one.

Several of the Florida cities have adopted the plan of indicating parking spaces by white lines painted on the brick or asphalt streets (which are common in the business centers). This idea is carried out quite completely by the city of Palatka. In the five or six blocks which constitute the business center of this city and which are paved with brick, parking spaces are indicated by white lines painted on the pavement running at an angle of about 45 degrees from the curb to another line parallel to the curb and a sufficient distance from it to permit parking between the curb and this line automobiles of ordinary length; the diagonal lines being a safe distance apart to provide abundant space for parking any width of truck between them. There is a city ordinance requiring automobiles to park at an angle with the curb, which method of parking permits any automobile to back into the free roadway without interference from or with the others parked next to it. This painting of the diagonal lines not only aids in this, but suggests to the forgetful, or to strangers who are

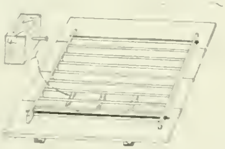
PARKING AUTOMOBILES, PALATKA.
The longitudinal and diagonal lines painted on the pavement can be seen faintly.

ignorant of the ordinance, that parking in this way is required.

For painting these lines several kinds of paint have been used, but we could not learn that any one kind had given decidedly better satisfaction than others. The painting of the lines has to be renewed every three to five months. In painting the lines, one side of a street for the length of one block is roped off for twenty-four hours, during which time the lines are painted and the paint allowed to dry. The photograph shows a short stretch of a Palatka street where these lines have been provided and where most of the parking spaces are occupied.

Homemade Concrete Form Spacers

The Contractors' Atlas illustrates a very useful and inexpensive concrete form spacer that is very convenient to have in stock and may easily be made on the job in odd moments. It consists essentially of a small concrete strut to use inside a form and separate the walls, that can be left permanently in position. It is 6 inches long, made with 1 :1 Portland cement mortar and cured for at least two weeks. A nail embedded in one end provides for its convenient attachment to wooden forms. Care should always be taken when using it in a horizontal position to set it with one of the cross section diagonals vertical.



These spaces can be cheaply and rapidly made in the collapsible form here shown that consists essentially of a wooden gridiron held together by two bolts through the end pieces, and supported on any convenient smooth platform or board. The bars of the gridiron are spaced far enough apart to give the required width for the spacers and are separated by filler blocks set as far apart as the required length of the spacer. Each filler block has drilled through the center a hole large enough to receive a wire nail inserted part way, so as to become embedded in the concrete and remain there when the filler block is removed. The mould is filled with mortar mixed dry and well rammed which should be allowed to set several hours before the mould is stripped.

New York Surface Railroads in Bad Condition

The street surface railroad lines in New York City need more than $6,500,000 to put their lines, cars and other equipment in first class operating condition. That the surface lines have deferred maintenance charges to the amount named, was stated at a recent hearing before the Public Service Commission for the First District, by R. H. Nexsen, electrical and equipment engineer. In some instances the deferred maintenance charge covers paving along the right-of-way, which some of the roads in receivership have frankly stated their inability to repair. Paving repairs are being made by the city, and the cost charged against the companies, to be later liquidated. In some cases the testimony showed that the cars of several companies need repairs to the extent of from $500 to $1,000 each. Cars, tracks and equipment generally, it was however stated, are at the present time in safe operating condition, but if repairs are much longer neglected the margin of safety will be decreased.

Highway Notes

Thomas H. McDonald, chief of the bureau of public roads of the United States Department of Agriculture, says that the bureau of public roads in its expenditure of Federal Aid funds is endeavoring to confine itself to two types of highways, namely, the low cost road involving primary work where the traffic is such that it can be carried on a sand and clay, gravel, or earth road or the high type road of a durable nature which would stand up under the heaviest traffic.

Roy D. Chapin, former chairman of the Highway Transport Committee of the Council of National Defense is quoted as saying that a survey conducted under the direction of the commissioner of education at Washington shows that 115 of the 127 technical schools are now giving courses of one kind or another in highway engineering.

Whether automobiles promote the improvement of highways, or good highways increase the number of automobiles, both of which are probably true, the fact remains that the number of automobiles in California last year increased 40.2 per cent., making that state the leader in the number owned in any state.

The transcontinental Lincoln Highway crosses eleven states that have already expended on or provided for it, during 1919, about $12,000,000, bringing the total expenditures since it was commenced in 1914, up to about $22,362,000. The 377.33 miles of new road built in 1919 included about 121 miles of concrete, 69 miles of gravel, 29 miles of macadam, 18 miles of bituminous macadam, 21 miles of brick and 117 miles of permanent earth grade and a little shale.

City Managers for Two Cities

East Radford, Va., has decided, by a vote of 358 to 241, for a City Manager form of government. An election will be held in June for the selection of three commissioners who in turn will elect a city manager, after they take office on the first of September.

West Liberty, Iowa, has voted through its councilmen to put practically all of the city's activities under the direction of a city manager at an annual salary of $2,000. The first incumbent will probably be former Mayor C. J. Mackey.

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FRANK W. SKINNER, *Associate Editor*

Up-to-Date Sewerage Work

The construction, now well advanced, of one unit of the sewage disposal plant for the city of Bridgeport is a piece of municipal engineering notable for the unusually thorough preliminary investigations, for the type of plant selected, and for the ability and practical success with which the work has been executed.

Years ago the city engineer foresaw the future necessity of eliminating the harbor pollution that is tolerated in so many towns and cities, and a thorough investigation was made by specialists who recommended the best system at that time available. Portions of this work, inseparable from any improved system, were immediately undertaken in the construction of intercepting lines, but before the disposal works were commenced the plans were reviewed, and it was believed that, in the light of later experience, the proposed treatment had proved unsatisfactory in other cities, and it was therefore decided to replace it by an entirely different method, fine screening, which was accordingly adopted.

The new plan, approved by the city engineer and other officers, and by experts, governed the design of the present pumping, screening and outfall works, which has been made with careful attention to safety, efficiency and economy, and includes important innovations, such as the location of the screen at the bottom of the pump well, improved method for handling the sludge without creating a nuisance, and a simple automatic control of the machinery.

The execution of the work involved serious uncertainties in the construction of a very large, deep well in difficult material below water level, where great difficulties were anticipated by outside engineers, and where the ordinary methods of constructing the substructure in a cofferdam would have involved great risks and large expense. The city engineer, after a careful study of conditions, did not hesitate to adopt a method frequently used for bridge piers and other important foundations, but seldom applied on so large a scale, which, with the character of the bottom, greatly increased the expectation of trouble. He adopted the dredged open caisson method, and successfully sunk a huge concrete shell under its own weight where it had been predicted that the skin friction would entirely prevent its descent to the required depth. The usual difficulties from incoming water and undermining were easily overcome, excavation was advantageously effected and the bottom was successfully sealed, enabling the work to be carried on economically and safely. A first-class mixing and hoisting plant was installed and concrete spouted to place for the continuous filling of the forms, and ingenious features were provided for the details of the work. In this way results were obtained that were far cheaper than would have been secured by doing the work with the pneumatic caisson process, which is the one usually adopted under conditions of this nature.

Difficulties of Municipal Financing

The $45,000,000 Hetch Hetchy water supply system for San Francisco, which is planned to bring from a long distance an abundant supply of pure mountain water adequate for domestic and manufacturing purposes for a long time, and at the same time to utilize the hydrostatic head for the operation of a hydro-electric plant that will conserve enough of the potential power to operate city utilities and produce a revenue of something like $2,000,000 per year, is a great financial as well as a great engineering undertaking. About $9,000,000 has already been expended on the preliminaries and on commencing construction as has been described in recent issues of PUBLIC WORKS and the supplementary railroad and hydro-electric development necessary for the main construction have already yielded a material revenue that will appreciably reduce the net cost of the enterprize.

Nevertheless the delay that must necessarily be caused by the slow driving of the 18-mile tunnel before the new water supply can reach the city, and the uncertainty of the exact cost, together with other reasons, make it difficult for the city just now to dispose advantageously of the $15,000,000 bonds issued on account of the water supply. As their present market value is about 87 and the city charter prohibits their being sold below par, it has been proposed to evade the legal restrictions by an agreement with local banks by which the latter shall nominally purchase the bonds for cash at par, actually paying $15,000,000, but immediately receiving a return payment of $2,400,000 to cover the difference of $1,875,000 between the market value and the par value and $525,000 for the 3½ per cent commission demanded by the banks.

These operations will be conducted by a superintendent who will subsequently supervise to some extent the contracts for labor, materials and equipment, bills for which will be approved by the city engineer, audited and paid by the city treasurer. These bills will include an estimated amount of about $10,000,000 for labor and material required to complete the mountain division in three years besides which $750,000 more will be paid to the superintendent for his services.

As the superintendent's services are apparently supererogatory in that he does little more than duplicate the work necessarily done by the city engineer's office, it appears that if this plan is actually carried out, it will practically amount to spending $3,150,000, or 21 per cent of the bond issue for the sole purpose of violating the clear provisions of the city charter. It may well be that the charter does not properly provide for the present contingency and that it needs revision or that some other relief is necessary to carry out vital improvements on the large scale requisite; if so, it would be much cheaper and better to revise the charter and finance the work in a straightforward way which would cost less and look much better.

Co-Ordination of Public Work

The plan to have all United States construction work placed in charge of a federal department of public works headed by a cabinet member has received intermittent attention for many years, and has recently been more widely urged, giving it an impetus that, if continued and augmented, may bring success. It is, however, necessary to maintain a vigorous and increasing promotion of this important subject so that its inertia may be that of a great moving, rather than that of a fixed mass.

Fortunately there have been no serious objections to the plan demonstrated, while its advantages are numerous and obvious. About the only disadvantages apparent are the questionable ones of the elimination of a large number of superfluous employes, the prevention of unnecessary and expensive duplications and interfering work, political opposition, and the not unnatural objections of existing government bureaus and organizations that will be combined, subordinated, or dispensed with by the new system. We can feel some sympathy with the last named, but it is tempered with the knowledge that all of the efficient and loyal members of present organizations will be first eligible for equal or superior positions in the new regime.

The great advantages are too unmistakable to need complete enumeration, among them are the simplifications, economy, and standardization of great operations that necessarily involve billions of dollars of expenditure and under present conditions are often greatly delayed and complicated. It is the only way to place this great work on an up-to-date business standing, to encourage zeal and efficiency, to secure the best design and execution of the work, to keep abreast of progress in other countries, and to insure dignity and appreciation for the great construction interests on which the progress, safety and prosperity of this country depend.

The revision and co-ordination of all the resources and activities constantly employed by the government on the hundreds of millions of dollars worth of work annually executed will make for tremendous improvement in research, equipment and production, it will enable matters of the highest import to be undertaken that cannot be carried out by individuals nor by dislocated branches of a heterogenous combination such as at present existing, and will provide information, equipment and organization accessible to the whole country, establishing standards of the first importance for the guidance and assistance of states and municipalities, thus saving vast quantities of public funds, expediting all kinds of important construction, and affording magnificent opportunities for individual effort in any direction for which the engineer, contractor, architect, designer, manufacturer and distributor are qualified.

The Proper Qualifications?

Engineering societies are almost universally notable for the high average of their personnel in individual attainments, technical ability, professional loyalty, standards and achievements, scrupulous ethics, and for progressive conservatism that makes for the best development.

Their membership includes a very high proportion of the best and ablest men in the profession and a low proportion of inferior engineers. Membership in the societies is the hall mark of professional standing, certifying to a satisfactory amount of preparation, qualifications, and actual successful experience. Election to the presidency is the highest mark of honor and dignity that can be bestowed upon a member by his associates, and is a supreme recognition of his professional abilities and of his qualifications to act as representative for the whole body with power and influence in its business, social and professional operations.

It is generally bestowed on members of ripe experience who are thoroughly grounded in all of the principal interests of the society and often distinguished for exceptional success or brilliancy in some of them, or for great fidelity to the profession. It is usual and fitting that they should be especially representative of the devotion which makes the profession the superlative interest of a lifetime and devotes increasing energy to it. The president should at least have the potential ability to engage in all the activities associated with the welfare of the society, with knowledge of their hardship, requirements, and general conditions, with broadmindedness, personal appreciation, and sympathy. Without these qualifications he lacks the full measure of deserving the position, as well as complete ability to fill it perfectly.

Similar considerations prevail in most other clubs, societies and associations; their chief executive is supposed to be especially representative of the personnel, influence and dignity of the body. Even an extremely brilliant, wealthy, or amiable member is not eligible to that high office on this account alone, especially if he be conspicuously limited in qualifications, environment, or personality.

There is no overwhelming reason why a capable woman cannot make an excellent computer, a first-class draftsman, an office executive, or engage in important research work. Many have proved their ability in these directions. There are, however, strong reasons that have prevented them from desiring or accomplishing much in the field of construction, political and financial operations of magnitude, and the various responsible engineering positions that demand wide and intimate research and experience in difficult and tedious operations that involve great hardship and many long years of supreme effort. The very few that have attempted it are unlikely to change the established order or even to continue with the resolution and determination necessary for success in a life work.

After all has been said, however, each body has the undoubted privilege of choosing its own president, and this right has been exercised, as noted in the personal column of this issue, by a western society of engineers, which has elected a woman for its president.

Recent Legal Decisions

HIGHWAY BID NOT PERMITTED TO BE WITHDRAWN.

E. W. Foley Contracting Corporation vs. Green, State Commissioner of Highways, Supreme Court of New York, Special Term, Albany County, August, 1919, 177 N. Y. Supp., 779. On the morning of the day for opening bids for the completion of a county highway the contracting company, through its vice-president, filed in the office of the Highway Department a bid for $118,205.50. At the time the vice-president had in his possession another prepared bid for $123,357.70, which bid he desired to deposit, but he was informed that he could not deposit the larger bid unless he deposited therewith three per cent of the amount of the bid. He had with him only a certified check for $3,600, which was sufficient to be submitted with the lesser of the two bids. Later the vice-president returned with $120 in cash, which he enclosed with the bid for the larger sum with the following memorandum:

"This bid supersedes one formerly deposited for $118,000, and check deposited with that bid applies to this one."

The other bids upon the contract being larger than the larger sum bid by the contracting company, the Highway Commissioner awarded the contract to the contracting company. The Attorney General rendered an opinion that after a bid or proposal for a highway contract had been deposited with the State Commissioner of Highways it could not be withdrawn, even with the consent of the Commission, unless an unintentional mistake had been made, for which a Court of Equity would grant relief.

The contracting company brought action, asking for a peremptory writ of mandamus requiring the Highway Commissioner to reject the first bid and to award the contract without considering it. The application was denied, the Court approving the opinion of the Attorney General, in which he said:

"Although in cases of private contracts a bidder can always withdraw its offer before its acceptance, a different rule prevails in the case of public contracts; the reason being that in public contracting all parties are operating under regulatory statutes and subject to the restrictions thereby imposed, and that, if bids were permitted to be withdrawn, the highest bidder might be made the lowest by the withdrawal of all other bids, thus producing fraud."

CONTRACTOR RESPONSIBLE FOR INJURY TO SUBCONTRACTOR'S EMPLOYE.

Cassin vs. Stillman, Delephanty-Ferris Company., 185 A. D. 63, Supreme Court, N. Y., Second Department, Appellate Division. The defendant was a general contractor for the construction of certain sheds at Weehawken, N. J., for the West Shore Railroad Company. Such contract embraced the roofing of the sheds, and a subcontract for such roofing was made with the H. W. Johns-Manville Company. The plaintiff was in the employ of the subcontracting company and was injured by the breaking of a ladder owned by the defendant, which he was using to gain access to the roof. He recovered a judgment against the Stillman, Delephanty-Ferris Company. The Appellate Division reversed the judgment and ordered a new trial. The syllabus of the case is in part as follows:

"Where the plaintiff, an employee of a subcontractor engaged in roofing a building, was injured by the breaking of a ladder owned by the defendant, the main contractor, the duty of the latter to the plaintiff must arise, if at all, out of its contract with the plaintiff's employer.

"The contract between the defendant and the subcontractor, the plaintiff's employer, did not in express terms require the defendant to furnish ladders for the employees of the subcontractor, and the plaintiff sought to enlarge the provisions of the contract by proof of a custom that general contractors furnish roofing contractors with such means of access to the roof. The only proof on this issue was that subcontracting roofers were accustomed to use ladders which the contractor brought to the premises for its own use. Held, that the evidence was insufficient to establish a custom enlarging the contract between the defendant and the subcontractor.

"In order to justify a decision that parties to a written contract intended to obligate themselves to do something which cannot be found in the terms of the contract itself, the custom must be shown to be reasonable, uniform, well settled and either known to the parties when the contract was made, or so generally known as to raise a presumption that they had it in mind at the time.

"Where it appeared that a form of contract submitted to the defendant by the subcontractor, and which required the defendant to allow the free and reasonable use of such facilities as might be available for handling materials, was rejected by the agent of the defendant who had charge of subletting the contract, it was reversible error to refuse to allow said agent to testify that he informed the subcontractor that he would not accept the contract because it bound the defendant to allow free use of said facilities, etc."

POWER TO MAKE PUBLIC IMPROVEMENTS OR GRANT AID THEREFOR.

(Ky.) Resolution of trustees of town of sixth class ordering sidewalk to be reconstructed without prescribing specifications or grade, did not delegate authority to fix specifications to engineer, and hence defeat lien on abutting property, since specifications and grade were fixed by the general ordinance under which the work was ordered.—Eisenschmidt v. Ader, 215 S. W. 48.

The ordaining of the specifications and grade of sidewalk improvement in town of sixth class is a legislative matter for the board of trustees, the board having no power to delegate the authority.—

NEWS OF THE SOCIETIES

April 12-17. — UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. — BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 27-29—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 4-6.—NATIONAL FIRE PROTECTION ASSOCIATION; Chicago. Secretary, 87 Milk street, Boston.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louts, Mo. Secretary, C. E. Drayer, 63 East Adame Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Aebury Park. Secretary-treasurer, D. A. Abrame, Lewie Institute, Chicago.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Aebury Park, N. J. Office of secretary, Philadelphia.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

◆

American Association of State Highway Officials.

A conference of delegates from 20 different states was recently held in the offices of the Bureau of Public Roads, Department of Agriculture, Washington, D. C., to formulate a system of standardized tests for road materials. The delegates, together with officials from the Bureau of Public Roads, and engineers of state highway departments, made suggestions for the elimination of inconsistencies and the preparation of specifications that it is hoped will be voluntarily adopted by the different states and counties so as to provide for very wide uniformity in production and construction.

Association of Mississippi Valley State Highway Departments.

At the recent annual conference in Chicago, resolutions were passed protesting against the construction of roads by the Federal Highway Department without state co-operation, and opposing propaganda of the American Automobile Association and others to lower motor vehicle fees regardless of financial conditions relating to highway improvements. Frank F. Rogers was elected president and Alexander Graham, Jefferson City, Mo., secretary.

American Concrete Institute.

There was a registration of 274 at the convention held at the Auditorium Hotel, Chicago, where among a large number of topics discussed and papers presented, there were included important ones on, Application of Water Ratio, Determining Volume-Weight of Aggregate, Standardization of Bar Sizes, Contractor's Plant, Sidewalks, Sewer Standards, Mixing, and Curing. The delayed recommendations of the Committee on Concrete Roads and Pavements will be published in the Institute's proceedings and the subject was discussed, among others by A. T. Goldbeck of the U. S. Bureau of Public Roads, who stated that investigations of the distribution of pressure on roadways, showed that stresses are small under static loads, even of heavy trucks, and that impact is the governing factor. For a fall of ¼ inch, the impact pressure may be almost three times as great as that due to the static loads and for a fall of 3 inches, this will become twice as much.

A joint session was held with the National Conference on concrete house construction. The officers elected were: President, H. C. Turner, New York City; vice-president, Charles R. Gow, Boston, Mass.; treasurer (re-elected), Robert W. Lesley, Philadelphia. Members of the Board of Direction: Edward A. Tucker, Boston; E. D. Boyer, New York; Arthur Bent, Los Angeles.

National Federation of Construction Industries.

There was an attendance of more than 300 at the first annual meeting at Hotel Sherman, Chicago. Gov. Allen of Kansas described the action taken in the recent famous coal strike and E. J. Russell, chairman of the National Board of Jurisdictional Awards, stated that a large proportion of the disputes brought before the board of three employes, three employers, one engineer and one architect, have been already settled, promising a stabilizing of the building industry and predicting that within five years, all disputes in the building trades that are now settled by strikes will be settled without strikes.

A representative of the U. S. Department of Labor announced that the department favors a conciliatory attitude toward present problems of unrest, rather than precipitate action.

Among the important points brought out in the discussion of various topics were, that railroad service is more important than rates, the seriousness of the car shortage, the drift toward world trade, the necessity for foreign trade, opportunities in South America, the inability of railroads to perform their required tasks no matter under what control they are, the necessity of quantity productions and of standardization to prevent waste. The following officers were elected by the Board of Directors: President, Ernest T. Trigg, Philadelphia; vice-presidents from the twelve districts—(1) Boston, F. T. Miller, president, F. W. Dodge Co.; (2) New York, Dr. J. T. Duryea, Pierce-Butler-Pierce Mfg. Corp.; (3) Philadelphia, Col. John R. Wiggins, John R. Wiggins, Inc.; (4) Cleveland, John A. Kling, Kelley Island Lime & Transp. Co.; (5) Richmond, Gen. R. C. Marshall, Washington, D. C.; (6) Atlanta, Col. Sam Tate, Tate Mfg. Co.; (7) Chicago, B. F. Affleck, Universal Portland Cement Co.; (8) St. Louis, Geo. W. Simmons, Simmons Hardware Co.; (9) Minneapolis, L. S. Gillette, Plymouth Investment Co.; (10) Kansas City, Walter S. Dickey, W. S. Dickey Clay Products Co.; (11) Dallas, J. H. Kirby, National Lumber Mfrs. Assn.; (12) San Francisco, John Garland, National Association of Real Estate Boards; treasurer, A. M. Maddock, Thos. Maddock's Sons Co.; managing director, J. C. Frazee; executive secretary, Maj. John L. Clarkson.

There were elected directors from all parts of the country, each representing a different interest or industry, such, for example, as contracting, clay products, lumber, investments, construction, machinery, etc. Four of them were continuing directors elected for two years, and two for one year; nine directors for three years, four for two years, and six for one year.

National Crushed Stone Association.

The third annual convention was held at Louisville, Ky., Feb. 9, 10 and 11. Delegates were present from 18 states and from Canada and the construction and maintenance of roads and streets were discussed as an important feature of interest to the stone industry. John Rice, Philadelphia, was elected president; A. B. Sandles, Columbus, Ohio, was re-elected secretary.

New York Section American Society of Civil Engineers.

At the meeting of March 24, Senate Bill No. 1258, indicator No. 1104, now before the Legislature, was discussed in connection with the subject of licensing engineers in New York.

Brooklyn Engineers Club.

The regular informal meeting of April 1st was devoted to the discussion of License Legislation and Professional Restrictions.

Mississippi Waterways Association.

The St. Louis Chamber of Commerce has issued invitations to the governors of all the states in the Mississippi Valley and mayors of all the principal cities, together with all civic organizations of cities located on the Mississippi and its tributary rivers, to attend the third annual convention of the Mississippi Waterways Association, to be held in St. Louis on April 19 at Hotel Statler.

Resolutions will be passed which will impose on the leaders of both national political parties the vital and immediate demand for increased transportation facilities. These resolutions will be offered to the Republican and Democratic parties to be incorporated in their platforms when they meet in June.

The United States Good Roads, Bankhead Highway and Albert Pike Highway Association's Conventions.

Director General Rountree stated that there has never been a meeting of the organization that seemed to have aroused the preliminary interest as the one to be held here next month. An indication of that fact is seen in the acceptance of the invitation by C. E. Milliken, governor of Maine, who will appoint delegates to attend the convention with him.

All of the governors are doing that. Chief executives who cannot come owing to previous engagements, have written that interest has been aroused in their states over the convention and that they are naming men they know are interested in good roads and who will be at these meetings.

Letters of positive acceptance have been received from the following governors:

Le M. Russell, Mississippi; A. H. Roberts, Tennessee; W. P. Hobby, Texas; C. E. Milliken, Maine; Peter Norbeck, South Dakota; R. G. Pleasants, Louisiana; J. B. A. Robertson, Oklahoma, and O. A. Larazola, New Mexico. It is also understood that Arkansas' chief executive, Charles H. Brough, who will succeed the late United States Senator Bankhead as presiding officer of the United States Good Roads Association, will also be at the convention.

A number of men who have been successful in promoting highway organizations in other states have been invited to deliver address. Among the number is Mr. A. F. Beament, secretary of the Lincoln National Highway.

L. G. Adams, president of the Alabama Automobile Dealers' Association, will attend and will appoint a delegation to represent the Alabama Automobile Dealers' Association at the coming convention.

Water Works Associations.

Committees appointed by the New England and by the American Water Works Associations are preparing a joint progress report including tentative specifications for water meters, on the basis outlined by meter manufacturers and expect to circulate their findings for consideration before the Montreal meeting of the American Association in June and the September meeting of the New England Association.

Illinois Drainage and River Improvement Association.

This association has recently been organized with 12 directors located in the principal river valleys as chairmen of their respective local committees. President, A. L. Maxwell, Lawrenceville, Ill.; secretary, G. W. Pickells, Urbana, Ill.

Engineering Institute of Canada.

The Toronto branch has passed a resolution calling on all branches to appoint committees to investigate and report on improving the economic status of the engineers.

United States Chamber of Commerce

The eighth annual meeting at Atlantic City, April 27-29, will be devoted entirely to the subject of increased production, with reference to governmental relations, to transportation, to internal finance, to agriculture and to labor.

North Dakota Society of Engineers.

At the 12th annual meeting, March 10th, there was an important discussion on roads and a committee was authorized to secure a revision of the state board of health rules requiring approval of all details in the design and construction of all water supply and sewage systems which have caused delay, friction and uncertainty of responsibilities. The formation of a federal department of labor was approved, and Esther M. Jack, city engineer of Williston, was elected president.

Joint Engineering Society Dinner.

Twelve prominent organizations gathered 300 strong March 30 in attendance at the eleventh annual engineers' dinner planned by the Boston section of the American Institute of Electrical Engineers, Boston Society of Civil Engineers and the Boston Section of the American Society of Mechanical Engineers. Participating with these organizations were the American Chemical Society, the American Institute of Mining and Metallurgy, the American Society of Civil Engineers, Engineers' Club of Boston, the Illuminating Engineering Society, the New England Water Works Association, Plant Engineers' Club, American Society of Heating and Ventilating Engineers and the Boston Society of Architects.

The principal speaker was Paul D. Cravath, New York, who was the legal representative in Europe of the United States Treasury Department during the war. He spoke on "Some Economic Aspects of the Treaty of Paris."

The toastmaster was Professor Dugald C. Jackson, of the Institute of Technology, and then chairman of the evening was Irving E. Moultrop, assistant head of the construction bureau of the Edison Electric Illuminating Company in Boston.

The Pike's Peak Ocean-to-Ocean Highway Association.—At the annual meeting, Feb. 25, C. F. Adams, Chillicothe, O., was re-elected president; W. H. Goodin, Lovelock, Neb., vice-president, western division, and E. E. Johnson, Colorado Springs, secretary.

PERSONALS

Hansen, Paul, until now chief sanitary engineer of the Illinois Safe Dept. of Health has become a member of the firm of Pearse, Greeley & Hansen, Hydraulic and Sanitary Engrs., 39 W. Adams St., Chicago.

Pennartz, R. H., has been appointed resident engineer on Federal Aid road work in Shawnee County, Kans.

Barnett, Howard H., city engineer of Pontiac, Mich., has resigned to engage in the practice of consulting engineering.

Lenhart, L. I., has been appointed city engineer of Pontiac, Mich.

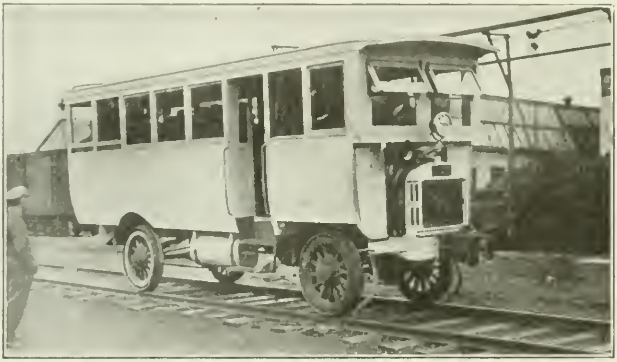
Rand, H. A., has been appointed road master of Clackamas Co., Oregon.

Compton, H. C., has been appointed district highway engineer at Boring, Ore.

New Appliances

Motor Cars on Rails, Illustrated.

The Palatine, Lake Zurich & Wauconda Railroad is using a 3-ton four wheel drive truck equipped with flanged wheels and passenger body on its 16-mile track from Wauconda to Paletine, Ill. The truck has a capacity of 80 passengers and hauls a 5-ton trailer loaded with freight and baggage. When not pulling a trailer the round trip of 32 miles is made on 6 gallons of gasoline. At one point on its route the truck climbs a seven per cent grade with full load. It is operated continuously from morning until night.



MOTOR TRUCK ON P., L. Z. & W. RAILROAD.

Thos. J. Lee, vice-president and general manager of the Palatine, Lake Zurich & Wauconda Railroad, said, "I think there is a great field for a truck which will operate successfully on a railroad, as there are about 250 short lines in this country which would be in need of them if the right car is built." The Butler County Railroad is reported to have also opened up a motor line from Fargus, Mo., to Tipperary, Ark.

Koehring Mixer Loaders and Mixers.

The loader is an independent loading unit for use where materials are placed on the subgrade. It It is a simple installation of a belt conveyor in a light steel frame that is operated and moved from job to job under its own power. By accurately proportioning the aggregate, it insures uniform concrete, cuts out all wheeling, increases yardage and decreases costs.

The mixer is coordinated with the paver, comes in sizes of 10, 14, 21, and 28 cubic foot bucket capacity with either boom and bucket or spout distribution, driven by steam or gasoline, and is efficient in continuous high speed operation, providing a very fast paving unit with a high yardage. These machines, bar cutters, bar benders, and other concrete equipment are manufactured by the Koehring Machine Company.

Safe Transport.

The "W. & T." Non-Spillable Shipping Container sold by Wallace & Tiernan Co., Inc., is applicable for transporting tubed media for the bacterial analysis of water and sewage. For the shipment of tubes of lactose broth or bile for the presumptive colon bacillus test and the transportation of any sample where safe carriage is desired and continued vertical position essential, these containers are recommended.

INDUSTRIALNEWS

Low Cost Shoveling.

A Thew Automatic Electric Shovel operated for nine months in 1917 and 1918 in a New York iron mine, handled about 13,000 tons of material at an average cost per ton of 16 1/10 cents. The ore was loaded into 3-ton cars which were hauled an average distance of 300 feet and the work performed was equivalent to hand labor that cost 30 cents per yard. Some of the mining shovels are made very simple and compact and can quickly be knocked down to pass through a 3-foot 6-inch x 3-foot 8-inch shaft.

The Dorr Company.

The Dorr Company, engineers, of 101 Park avenue, New York City, has recently arranged for the separation of its domestic sewage and trade waste from its industrial activities by organizing a Sanitary Engineering Department. All matters, including engineering service, pertaining to treatment of domestic sewage, waste waters of tanneries, glue, gelatine, milk products and corn products factories; cotton, silk and textile dyeing and finishing mills, canneries, brass, steel and rolling mills, paper mills, etc., are now being handled by the Sanitary Engineering Department.

Colonel I. L. Reeves, C. E., formerly president of Norwich University, and more recently president of the A. E. F. University, of France, has resigned from the army to accept the management of the department. Mr. C. Lee Peck, industrial engineer, continues in charge of the research and development work, while Mr. R. H. Eagles, also of the Dorr Company staff, will assume charge of the information and extension division.

Sullivan Machinery Co.

This company has issued a number of bulletins illustrating and describing a great line of air compressors, angle-compound air compressors, portable gasoline driven air compressors, motor driven air compressors, compound Corliss air compressors, water hammer drills, valveless stoping drills, drill sharpeners, plug drills, and a utility hammer operated by compresed air or steam.

Mathieson Alkali Works, Inc.

Kienle, John A., formerly sales manager of the Electro Bleaching Gas Company, has been appointed general manager of sales of The Mathieson Alkali Works, Inc. This change was brought about by the severing of relations between The Mathieson Alkali Works, Inc. and its former sales agents, The Arnold, Hoffman & Co., Inc.

It is the intention of the Mathieson Alkali Works, Inc. to sell all of its products (caustic soda, soda ash, Virginia soda, bicarbonate of soda, bleaching powder, liquid chlorine, chlorine solvents, etc.) direct to the consumer instead of through sales agents.

Mr. Kienle has been placed in charge of the development of a complete sales organization.

PUBLIC WORKS.

CITY COUNTY STATE

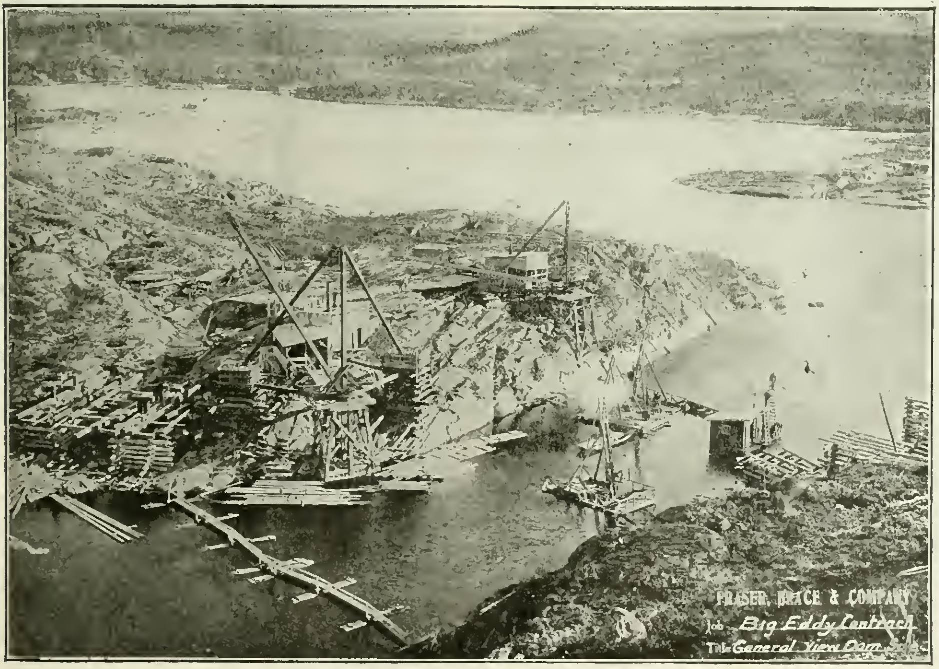
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, APRIL 17, 1920 No. 14

Big Eddy Storage Dam

Concrete structure 1,100 feet long and 159 feet high built in sections in rocky bed of Spanish River, Canada, to serve hydro-electric plants. New York contractors reconstructed miles of railroad, leveled river bed under water, excavated by-pass channel in rock, constructed workmen's camp for 700, and equipped field shops and power plant for construction purposes.

The Big Eddy Dam is now in an advanced stage of construction across the channel of the Spanish River at Turbine in the province of Ontario, Canada, about 4¼ miles from the Soo Line of the Canadian Pacific Railroad, and about 25 miles from the International Nickel Company's mine and smelter, where it is being built in order to provide additional water storage and regulate the river flow for the nickel company's hydro-electric plants located lower down in the river valley.



GENERAL VIEW OF SITE OF BIG EDDY DAM.

LOGHOUSE WATERPROOFED WITH BUILDING PAPER FOR PRELIMINARY CAMP.

The Spanish River has a flow varying from 1,600 second-feet to 16,000 second-feet at the dam site which is in a narrow rocky gorge 130 feet wide, with a normal depth of water there of 45 to 55 feet. The low water velocity is about 4 miles per hour and the river is subject to severe floods and heavy ice fields that make any channel construction difficult and expensive.

The 6,000-acre storage reservoir to be created by the dam, will extend 20 miles upstream and will have a maximum depth of about 100 feet. The dam itself is of concrete with a gravity section about 100 feet wide at the base and 159 feet high to the lowest point of the foundation carried to satisfactory bearing below the original surface of the river bed. The length is 1,100 feet consisting of a 512-foot bulkhead, a spillway section having 19 openings, 17 feet wide between piers, a 152-foot section with four steel penstocks 12 feet 6 inches in diameter, and an exciter penstock 5 feet in diameter and provisions for a trash run and log slide.

The regulating sluice section is 60 feet long and is located in the river section. When the river is not running over the spillway, the flow will be controlled by discharging through three 78-inch Larner-Johnson valves, having a combined capacity of 3,700 second-feet with full head. The valves weigh 25 tons apiece, and with the intake and discharge tube connections weigh 52 tons. For erection they were suspended by rods threaded at the upper end so as to permit of easy adjustment in regard to level and grade, while horizontal adjustment was made by jacks.

The finished dam will contain about 88,000 yards of 1:2:3 concrete made with gravel from a pit 15 miles distant, and slag from the smelters of the International Nickel Company and containing up to 20 per cent of plums. The contract for the construction of the dam was awarded to Fraser, Brace & Co., Ltd., Montreal and New York.

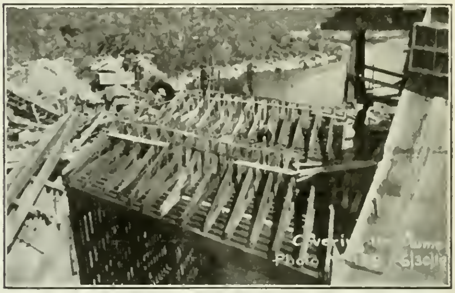
PRELIMINARY OF OPERATIONS.

Work was commenced in August, 1918, by the contractor, who, to facilitate transportation of plant, equipment and materials to the dam site reconstructed 3½ miles of standard gage railroad, previously laid from the Canadian Pacific Railway and Algoma Eastern Railway tracks at Turbine, which they relaid with heavier rails, improved the grade and alignment, and extended it ¾ of a mile farther through very rough country involving 6,550 yards of rock excavation, 6,100 yards earth cut, 5,000 yards of borrow pit excavation, and the construction of a wooden trestle 945 feet long and 50 feet high.

Preparations were made at the outset to provide for about 700 men for two years or more at this remote point in the wilderness where there was no improvements, and where the long winters are very severe, with deep snow and intense cold. A camp was, therefore, immediately built at the site with three dining room and kitchen buildings, each having a capacity for 225 men, besides the bunk houses, commissary, cottages, offices, store houses, shops and other buildings.

Close to the dam the surface of the ground is so rough and broken that no attempt was made to place the buildings there and they were located on a side hill where it was necessary to make the larger buildings long and narrow to avoid considerable expense in levelling the site.

Most of the bunk houses are 35 feet wide and from 100 to 150 feet in length but are divided into sections by transverse partitions 13 feet apart, thus making separate quarters for groups of 16 men each. Several 16 x 24-foot houses were built for the foremen and married men. The store house and commissary was 30 feet wide, 75 feet long and two stories high and the 30 x 35-foot office building was also two stories high. The kitchen, office and most of the bunk houses are heated from a central heating station containing three vertical type boilers and a general washroom provided with hot and cold shower baths and wash basins. Temporary quarters were at first provided by log cabins which were replaced with framed and sheeted houses as soon as the sawmill was put in operation.



TEMPORARY TIMBER CONSTRUCTION OVER FLUME TO CARRY WET CONCRETE OF MAIN DAM.

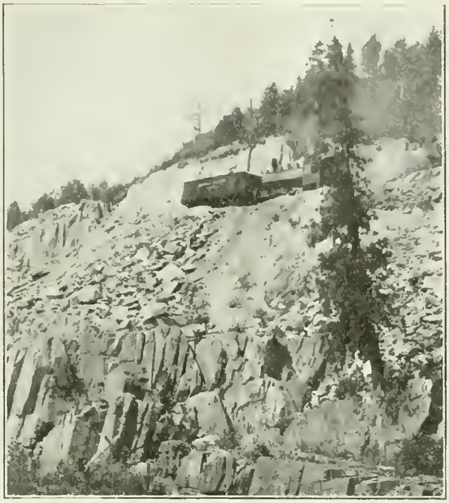
Compressed air to operate rock drills, hoisting engines and other machinery and for the pneumatic caissons used in the cofferdam and foundation work was provided by one low pressure compressor with a capacity of 1,200 feet, one high pressure compressor with a capacity of 500 feet, and two high pressure compressors with capacities of 1,050 feet per minute all operated by steam from a battery of five 100 h. p. bricked-in type boilers that were later superseded by electric motors operated by current received from the Nickel Company's plant at High Falls 25 miles distance. This current was received at a small transformer house at 35,000 volts and stepped down to 550 volts for the motors and 110 volts for lighting.

The power house operates the lathe, shaper, threading machine, drill press and power hack saw in the machine shop and the band saw, rip saw, rip and butt saw, swing saw and planer in the carpenter shop and is available for any purpose necessary in the adjacent smith shop.

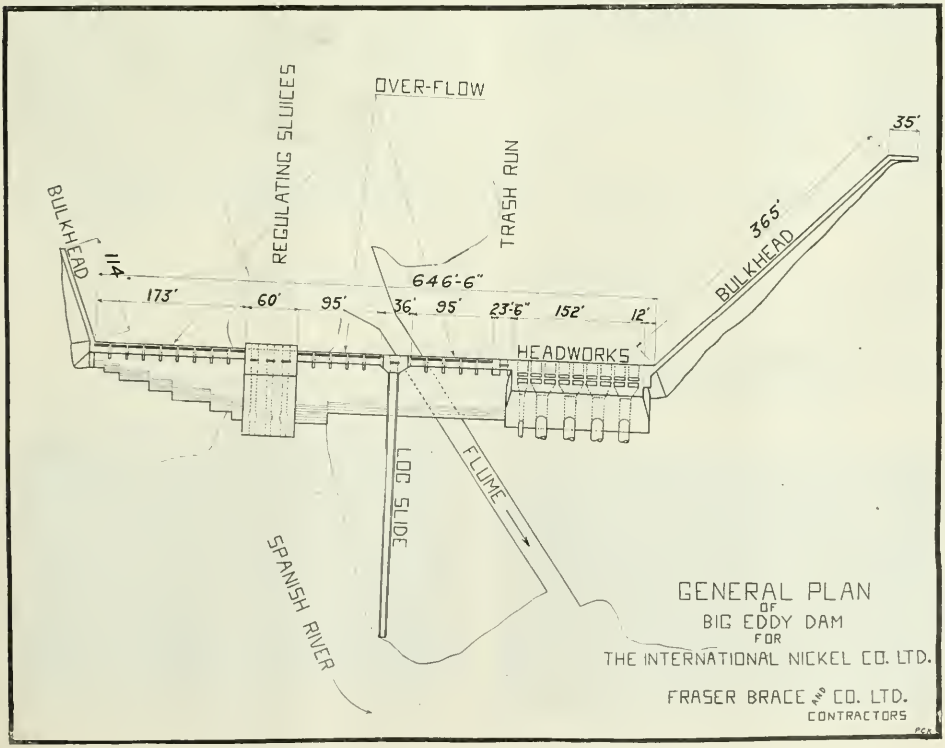
BY-PASS CHANNEL.

In order to divert the river from the dam site and allow the latter to be unwatered between the cofferdams, an artificial channel, called a flume, 25 feet wide, 28 feet deep, and 550 feet long, was excavated through earth and rock in a slight natural depression about 100 feet back from the east bank of the river. This channel, which was really a canal rather than a flume, required 14,000 yards of solid rock excavation which, after being blasted was loaded by stiffleg derricks into 6-yard cars, run out on a service trestle and dumped in piles on the river bank where it was accessible to be later reclaimed and used for plums in the massive concrete.

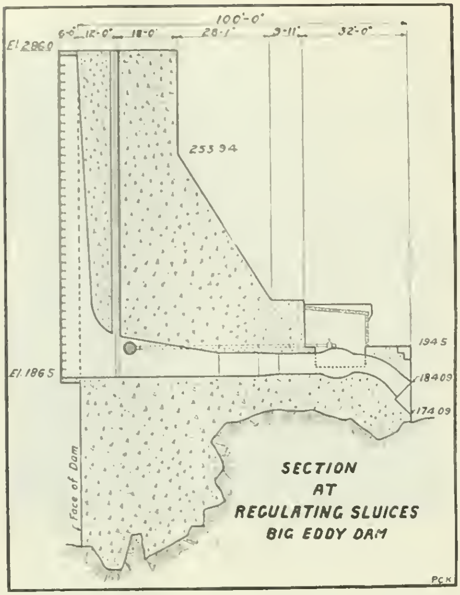
Where the by-pass intersects the permanent dam, the bottom and sides were lined with concrete and bearings were provided at the upstream and downstream faces of the dam or stoplog so as to enable the flow through the east flume to be regulated at will.



ROAD TO BIG EDDY DAM.
Showing difficult nature of country for transportation.



GENERAL PLAN OF BIG EDDY DAM.



SHOWING GENERAL AND SPECIAL FEATURES OF CROSS-SECTION AND EXTREME IRREGULARITY OF ROCK FOOTING.

Later on as the elevation of surface of the concrete in the main dam was carried up above the bottom of the flume, the latter was covered up 42 feet above its floor, by a roof consisting of lagging supported on wooden beams and trusses forming a sort of saw tooth construction that supported the wet concrete above it and enabled the dam to be built full length continuously above the flume while the latter was in service, supplemented by sluices in the lower part of the dam. When the water of the channel of the river had been raised 5 feet above normal by the cofferdam, the flume readily carried off the average summer flow of 1,500 second-feet and even handled an increased flow of 5,300 second-feet without injury to the cofferdam

LEVELLING THE RIVER BOTTOM.

At the dam site, the rock bottom of the channel was originally pitched steeply with the axis of the dam and upstream, and was covered up to a depth of 30 feet with large and small boulders and debris from the adjacent banks, making it very difficult to begin the construction of either the cofferdams or the foundation for the permanent structure.

The bottom was therefore approximately levelled by submerged drilling, blasting and excavation. Floats, equipped with Ingersoll-Rand drills, were moored in the channel and holes from 10 to 15 feet deep were drilled in the bolders and in the surface of the rock wherever necessity was indicated by soundings. Casing pipes were inserted in the holes and through them charges of 60 per cent dynamite were placed that, when fired, levelled the bottom sufficiently to give necessary bearing for the cribs and for the cutting edges of the caissons.

After the levelling was substantially completed, the bottom was inspected by divers who in some places built up piers of concrete bags to form temporary supports, sometimes several feet high, to conform to the irregularities remaining in the bottom and give necessary bearing for the caissons.

Comparison of Gasoline and Electric Pumping

At the water works plant of the Windsor, Conn., Fire District an electrically operated pump is found to be 20 per cent cheaper to operate than a gasoline one, and reliable as well as convenient to operate.

By H. R. Turner *

The water supply for the town of Windsor in Hartford county, Connecticut, is obtained from an impounding reservoir situated on the west edge of the town. From here the water is pumped to a standpipe one and one-eighth miles east of the reservoir and is supplied thence by gravity to the town, where it provides water for a population along the pipe lines of about 4,000 inhabitants.

The water company, a private corporation, owned the plant until 1915, when it was purchased by the Windsor Fire District, an incorporated part of the town of Windsor. Material enlargements to the pumping plant and distribution system were made at this time under the supervision of the writer. The pumping station in 1915 consisted of a pair of No. 80 Rife rams and a 10 h. p. single-cylinder, 4-cycle, vertical gasoline engine direct-connected to an 8x12-inch Goulds triplex single-acting pump, having a capacity of 300 gals. per minute. This machinery was housed in a frame building 16 ft. by 24 ft., constructed of stucco on wire lath, with a tin roof.

The gasoline driven unit was retained and modified to suit an increased head pumped against, due to the erection of a standpipe 105 ft. high. The modification was accomplished by changing the gear ratio on the pump, reducing the volume of water pumped from 300 to 200 gals. per minute. This outfit is now in use as a spare unit for emergency pumping only.

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*Engineer-manager Windsor Water Department.

NEW ELECTRIC PUMP.

The new pumping equipment installed in 1915 consisted of a 10x12-inch Smith-Vaile triplex, double-acting pump, having a capacity of about 1,050 gals. per minute, and operated by a 100 h. p. Westinghouse slip ring motor, through chain drive. Power was furnished by the Hartford Electric Light Company at 4,800 volts, reduced to 220 volts at the station. The apparatus was controlled automatically by a Westinghouse alternating current magnet switch starter, actuated by a pressure gauge switch. This automatic starter provides for emergency operation, but under normal operating conditions an attendant is present to care for oiling, chlorine control, etc.

The power is sold by the Hartford Electric Light Company in accordance with the following monthly schedule:

	Per k.w.
1st 500 k.w.	$0.05
1,000 k.w.	.04
3,500 k.w.	.032
65,000 k.w.	0.19

From these rates a reduction of 40 per cent is allowed for pumping between 10 p. m. and 7 a. m. On this account the pumps are operated between these hours unless an emergency requires operation during the day time. The current consumed averages 0.98 k.w. per 1,000 gals. pumped.

The gasoline driven unit is supplied from a 500-gal. storage tank in the ground outside the pumping station, which is piped direct to the engine. The gasoline consumption is about 1.04 gals. per 1,000 gals. of water pumped. This outfit is operated for emergency only.

OPERATING COSTS.

The actual fuel operating costs of the two units are as follows:

	Per 1,000 gals.
Gasoline driven pump	$0.025
Electric	.017

TESTING PUMP WITH CALIBRATED NOZZLE AND PITOT TUBE.
Arrow points to chlorine house.

WINDSOR PUMPING STATION.

These figures are based on gasoline at 24 cents per gallon wholesale price in December, 1919, and electric power on the sliding scale as above noted for one month's cost in which 9,215,000 gals. were pumped at a cost of $156.53.

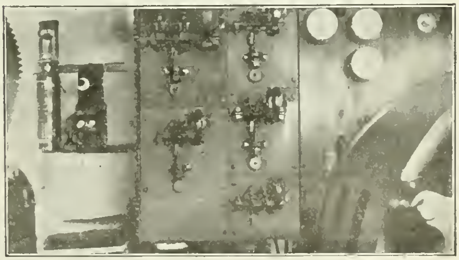
The total operating cost of the electric driven unit for six months' operation ending December 1, 1919, was $1,265.53, for a pumpage of 45,913,000 gallons. This is equivalent to $0.0276 per 1,000 gals. pumped. The dynamic head pumped against is 273 ft., and the cost of pumping 1,000,000 gals. raised one foot is $0.101. The above figures for six months' operation cover oil and grease, attendant, power charges and repairs, but do not cover interest on investment or depreciation.

An approximate comparison of costs of gasoline and electric driven pumps under our conditions is as follows:

	Gasoline, cost per 1,000 gals.	Electric, cost per 1,000 gals.
Attendant	$0.0081	$0.0081
Power	.0250	.0170
Oil, grease, etc.	.0005	.0009
Repairs	.0011	.0016
Total operating costs	$0.0347	$0.0276

A comparison of the depreciation and interest charges cannot be made easily, since the two units are so different in size and capacity, being about one for the gasoline to five for the electric pump.

Operating conditions are not ideal by any means. There is no filtration plant, and the water pumped often contains grit and sand during periods of high run-off on the streams entering the reservoir. This requires frequent and regular inspection of pump



AUTOMATIC STARTING EQUIPMENT.
Pressure gauge switch in the upper right-hand corner.

valves and piston packings in order to reduce slippage to its lowest amount. We have adopted a valve known as the Branden valve, which is a hard-rubber valve reinforced with metal to reduce danger of breakage. Piston packing, known as Goodsell's Dollar Packing, which is stitched on the outer edge, has been found to have a longer life than ordinary types, which soon deteriorate under our operating conditions.

While the electric power is not absolutely reliable, we have never been without power for more than six or seven hours at one time, and those occasions are very infrequent. Under general conditions in this locality the writer would not hesitate to recommend an electric power installation rather than a gasoline or fuel oil unit, since the advantage of simplicity of operation and self-contained machinery more than offsets the charge of unreliable service which an experience of five years in this location has shown to be negligible.

The Wanaque Dam

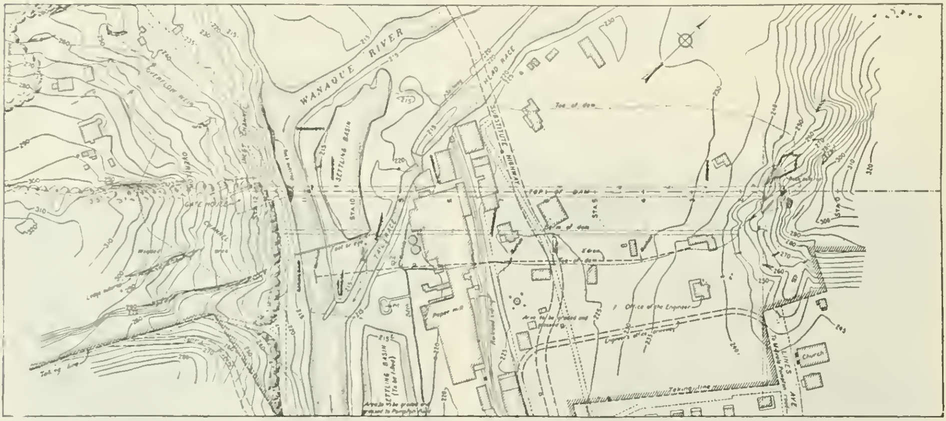
North New Jersey water supply to be provided by impounding run-off from a 94-square-mile water shed in a reservoir of eleven billion gallons capacity, formed by constructing an earth dam 75 feet high and 1,200 feet long, to be built in about 3½ years. Special construction features are involved by the requirements of the rigid specifications for imperviousness of embankment and concrete; extreme depth of core-wall trench, and the maintenance during the first year of construction operations of continuous flow in this river and a water supply to a large paper mill that will remain located and operating near the center of the dam site for months while construction is in progress around it. Up-to-date, sanitary requirements. Rational classification of excavation items.

The North Jersey District Water Supply Commission of the State of New Jersey proposes to construct a large impounding reservoir on the Wanaque River, with a total capacity of about 11,000,000,000 gallons. It will be formed by building a large earth dam to be known as Wanaque Dam. The work is located near the villages of Wanaque and Haskell in the County of Passaic, State of New Jersey, and is about 11 miles northwest of the City of Paterson.

The work will include the construction of an earth dam with a concrete and clay puddle core-wall, concrete gate house, concrete overflow weir and overflow and inlet channels in rock which embraces about 500,000 cubic yards of embankment, 90,000 cubic yards of concrete, 14,000 cubic yards of paving, 120,000 cubic yards of earth excavation, 65,000 cubic yards of rock excavation, 10,000 cubic yards of clay puddle, 9 3x4-feet and 4x5-feet sluice gates, and other appurtenances.

GENERAL DESCRIPTION.

Wanaque Dam is to be an earth embankment about 1,200 feet in length with a maximum height of about 75 feet, having a concrete and puddle core-wall carried down to rock 100 feet or more below the surface at the deepest point. The up-



GENERAL CONTOUR PLAN OF DAM SITE, SHOWING PAPER MILL INSTALLATION TO BE TEMPORARILY MAINTAINED AND BOUNDARY LINES OF PRESENT AND FUTURE PROPERTY LIMITS.

stream slope of the dam will be protected by a stone pavement and the top and down-stream slopes will be grassed. A masonry overflow weir about 550 feet long founded on solid ledge rock will be built along the hill at the southerly end of the dam. Down-stream from the weir an overflow channel will be excavated in earth and rock to lead the flood water back to the bed of the river below the dam. A gate house will be located at the junction of the earth embankment and overflow weir, which will contain the necessary sluice gates and machinery for drawing water from an open inlet channel formed by an excavated trench and retaining walls into the effluent conduit and for blowing off into the river below the dam. Two diversion dams designated as Midvale dam and Wolf Den dam will be constructed on the rim of the reservoir where shown on the drawings. A substitute highway and driveways will be constructed as shown on the drawings. Sludge from the paper mill and soil will be removed from the dam site and some grading of the grounds below the dam will be done. After April 1, 1921, when ordered, such buildings and structures of the Wanaque River Paper Company, as required on the drawings, shall be demolished and all debris and materials removed.

The axis of the dam intersects at approximately right angles the axis of the Wanaque River, the principal building and the head and tail races and large settling basin of the paper mill, and abuts at both ends on the steep hillsides to which it is anchored by the continuous concrete core wall, 12 feet thick at the base, built in a deep trench excavated in ledge rock to sound material.

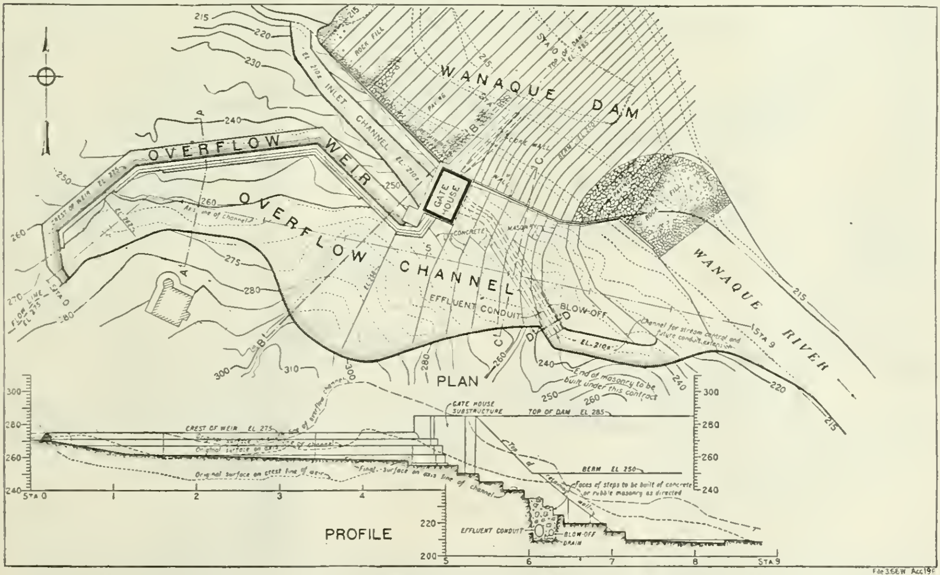
The dam is 15 feet wide on the crest and about 375 feet wide at ground level in the highest place, with side slopes of 1:2, 1:2½ and 1:3. The core wall, 5 feet thick at the top, is battered 20 on 1 on both faces to a maximum distance of 70 feet below the top, below which point the faces are vertical and in the cut-off trench.

The cut-off trench, 22 feet wide at the deepest point, is parallel to and 11½ feet down stream from the dam axis. It is 22 feet wide, lined with steel sheet piles, and concentric with the core wall, the spaces between which and the sheet piling are filled with puddled clay.

The overflow wier, located on the rocky hillside, is a concrete structure continuous with the concrete gate house and core wall construction. It is roughly U-shape in plan, about 520 feet long, 30 feet and 33 feet in maximum height and width. It is built of cyclopean concrete, except the down stream side, which consists of horizontal steps or offsets of rubble masonry.

CONTRACTION JOINTS.

Contraction or slip joints shall be formed where and as directed in the overflow weir, retaining walls and wherever shown on the drawings or required, by building smooth faces, acceptably coated to prevent adhesion with the adjacent masonry. Such joints as required, principally in the overflow weir and gate house, shall have copper strips incorporated therein as indicated on the drawings to form a continuous watertight stop from the bottom of the joint to the top. That part of the copper strip which is embedded in the masonry shall be clean and bright to form a good bond; the remainder shall be coated as required to prevent adhesion. Care shall be taken to protect the copper strips from injury during the construction of the joint.



PLAN AND PROFILE OF OVERFLOW WEIR AFTER SOME EXISTING BUILDINGS SHALL HAVE BEEN REMOVED.

The Specifications.

The specifications are very comprehensive and unusually clear and definite, evidently intended to give the contractor as complete and reliable, useful data as practicable regarding conditions and requirements.

ESPECIAL FEATURES.

Attention of bidders is especially directed to the magnitude of the work and to the contract requirements as to the time of beginning and order of doing the work to meet flood conditions, the temporary occupancy of a part of the site by the Wanaque River Paper Company, the necessity of maintaining a continuous supply of water to the Wanaque River Paper Company and a continuous flow in the Wanaque River, the housing and sanitary regulations and requirements, the early construction of the substitute highway, the rigid requirements of the specifications for securing impervious masonry and embankment and to the difficulties which may be met with in excavating the deep corewall trench and the provisions of the contract whereby there are periodical financial adjustments between the commission and the contractor with respect to payments for labor.

CONSTRUCTION MATERIALS AVAILABLE.

The country in the vicinity of the proposed work has been explored for sand, gravel, stone, clay, and impervious earth for embankments. In order to obtain suitable materials for the upstream impervious embankment and clay puddle, hauls of up to 1½ miles may be required and large quantities of stripping and clearing of the surface will be necessary. Where found, the suitable deposits are in general only from 6 inches to 3 feet in thickness. Sand, gravel and stone appear to be available near the dam site. Most of the sand and gravel will require screening.

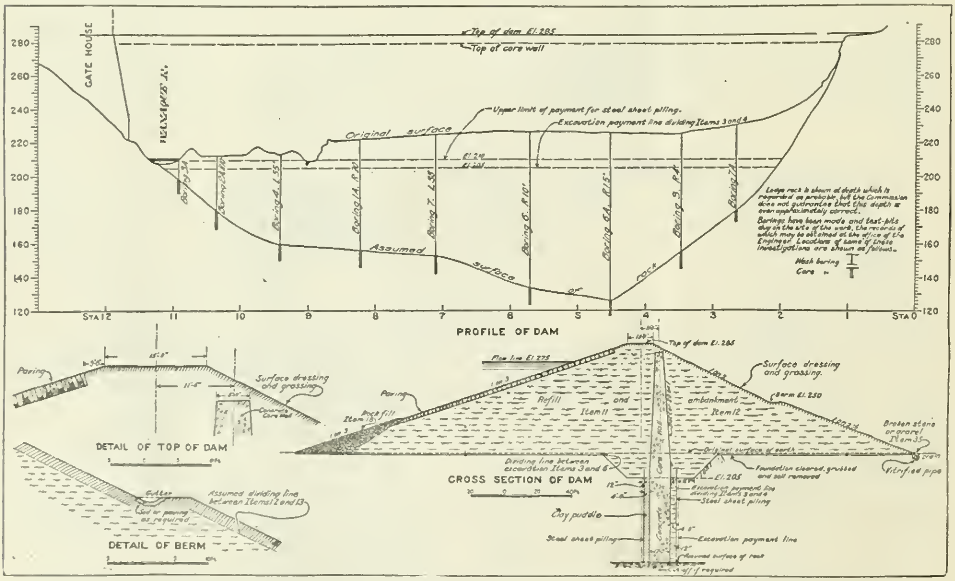
PLANT AND METHODS.

It is the purpose of the commission to build the works under its charge in the shortest time consistent with good construction. To this end, contractors will be required to use improved methods and appliances for doing the various parts of the work. Complete and well-designed construction plants and effective organization will be insisted upon. Special plant and equipment will be needed for removing the thin layers of suitable earth for embankment from over large areas, placing this material in its final position, and for driving the steel sheet piling and excavating the core-wall trench of the dam to ledge-rock.

Before the award of the contract, any bidder may be required to show that he has the necessary facilities, plant, experience, ability and financial resources to perform the work in a satisfactory manner, and within the time stipulated, and that he has had experience in constructing work of the same or similar nature.

RAPID PROSECUTION OF WORK REQUIRED.

The contractor shall commence the work embraced in this contract within 10 days after the service of notice by the engineer on him instructing him to begin work, and shall complete the same in all respects by December 1, 1923, unless delay in awarding contract or delay for any reason, in serving notice by the engineer to begin work shall exceed fifteen days after the date of opening bids. The central portion of the site of the dam will be


Top of dam El. 285
Top of core wall
GATE HOUSE
Upper limit of payment for steel sheet piling.
Excavation payment line dividing Items 3 and 4
Original surface
El. 210
El. 205
Boring 2A
Boring 8A
Boring 4
Boring 1A
Boring 7
Boring 6
Boring 6A
Boring 9
Boring 7A
Assumed surface of rock
Ledge rock is shown at depth which is regarded as probable, but the Commission does not guarantee that this depth is even approximately correct.
Borings have been made and test-pits dug on the site of the work, the records of which may be obtained at the office of the Engineer. Locations of some of these investigations are shown as follows.
Wash boring
Core
280
260
240
220
200
180
160
140
120
Sta 12
11
10
9
8
7
6
5
4
3
2
1
Sta 0
PROFILE OF DAM
Paving
15'-0"
11'-6"
Surface dressing and grassing
Concrete Core wall
DETAIL OF TOP OF DAM
Gutter
Sod or paving as required
Assumed dividing line between Items 12 and 13
DETAIL OF BERM
Top of dam El. 285
Flow line El. 275
1 on 3
Rock fill Item 18
Refill and embankment
Item 11
Item 12
Surface dressing and grassing.
1 on 2
Berm El. 250
1 on 2½
Broken stone or gravel Item 35
Drain
Vitrified pipe
Original surface of earth
Dividing line between excavation Items 3 and 6
Foundation cleared, grubbed and soil removed
El. 205
CROSS SECTION OF DAM
Excavation payment line dividing Items 3 and 4
Steel sheet piling
Clay puddle
Concrete Core wall
Excavation payment line
Assumed surface of rock
Cut off if required

GENERAL CROSS-SECTION OF DAM, SHOWING DETAILS OF SLOPE, PROTECTION AND CORE-WALL. LONGITUDINAL PROFILE DIAGRAM, WITH LOCATION OF PRELIMINARY EXPLORATION ROCK BORINGS.

occupied by the Wanaque River Paper Company until April 1, 1921, and the contractor will be required to complete before this date the excavations in connection with the inlet channel, overflow channel, overflow wier, gate house and that part of the core-wall trench not located on the lands reserved for the Wanaque River Paper Company, and the construction of the core-wall at least up to the original surface of the ground within these limits and the overflow weir except a section to be left open for flood control to be designated by the engineer. Unless otherwise ordered the Midvale dam shall not be built until the highway which crosses its site has been closed.

The time in which this contract and each part thereof is to be performed and the work thereunder is to be completed is of the essence of this agreement.

If the engineer considers it necessary the contractor must prosecute the work by night as well as by day, but shall receive no extra compensation therefor.

MAINTENANCE OF PAPER MILL ON DAM SITE.

While the Wanaque River Paper Company continues to occupy its present location, on the dam site, until April 1, 1921, the contractor shall not interfere with, nor foul the water in the head race, nor obstruct the flow in the tail race except as required. Except as otherwise required, an uninterrupted full supply of water at maximum levels shall be maintained in the head race until April 1, 1921.

ACCEPTABLE RIVER CONTROL AND CONSTRUCTION SCHEDULE.

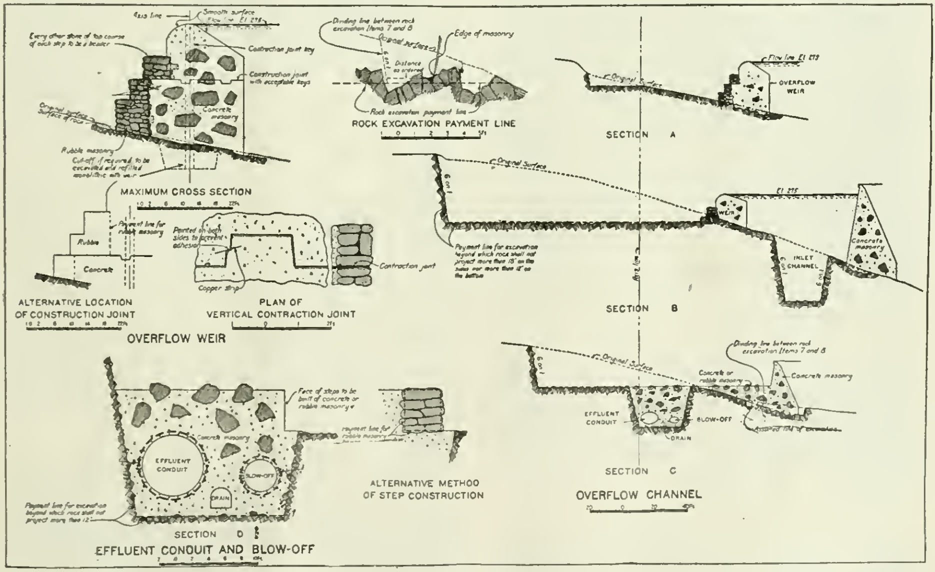
During the year 1920 and up to April 1, 1921, the ordinary and flood flows of the Wanaque River may be allowed to continue to flow either through the existing river bed or through the tail race, the flow being shifted to the tail race while building the core-wall under the river up to the level of the river bottom. Immediately after April 1, 1921, the stream-flow through the tail race shall be discontinued, in order that the core-wall trench through the paper mill site may be started, and the stream-flow will be limited to the original river bed.

Before the stream-flow may again be diverted from the river bed a new channel shall be provided through the inlet channel and effluent conduit trench and the contractor shall excavate the inlet channel and the effluent conduit trench and lay the foundations of the gate house before closing the river bed for a second time.

When all of the core-wall except that across the river bed has been completed to at least elevation 240 and the down-stream embankment to at least elevation 225 the old river bed may be closed and the stream-flow turned into the inlet channel, after which the dam in the river bed may be carried up to elevation 235, no earth being deposited on the down-stream side until the core-wall has reached elevation 225.

Meanwhile the work on the remainder of the dam shall be continued but the part south of Station 10 + 75 shall be continuously maintained at an elevation at least 5 feet below the other portions of the dam in order to provide for the passage of any floods which might exceed the capacity of the inlet channel.

When the embankment and core-wall have been built up to elevation 245 the construction of the gate chamber may be begun. The northerly portion of the gate chamber site may be dammed off and a part of the chamber constructed up to above the lower sluice gate opening.


Axis line
Smooth surface
Flow line El 275
Every other stone of top course of each step to be a header
Contraction joint key
Construction joint with acceptable keys
Original surface
Surface of rock
Concrete masonry
Rubble masonry
Cut-off if required to be excavated and refilled monolithic with weir
MAXIMUM CROSS SECTION
Payment line for rubble masonry
Rubble
Concrete
ALTERNATIVE LOCATION OF CONSTRUCTION JOINT
Painted on both sides to prevent adhesion
Copper strip
Contraction joint
PLAN OF VERTICAL CONTRACTION JOINT
OVERFLOW WEIR
Dividing line between rock excavation Items 7 and 8
Original surface
Edge of masonry
Distance as ordered
Rock excavation payment line
ROCK EXCAVATION PAYMENT LINE
Flow line El 275
Original Surface
OVERFLOW WEIR
SECTION A
Original Surface
El 275
WEIR
Payment line for excavation beyond which rock shall not project more than 18" on the sides nor more than 12" on the bottom
Axis line
INLET CHANNEL
Concrete masonry
SECTION B
Face of steps to be built of concrete or rubble masonry
Concrete masonry
EFFLUENT CONDUIT
BLOW-OFF
DRAIN
Payment line for excavation beyond which rock shall not project more than 12"
Payment line for rubble masonry
SECTION D
EFFLUENT CONDUIT AND BLOW-OFF
ALTERNATIVE METHOD OF STEP CONSTRUCTION
Original Surface
Dividing line between rock excavation Items 7 and 8
Concrete or rubble masonry
Concrete masonry
EFFLUENT CONDUIT
BLOW-OFF
DRAIN
SECTION C
OVERFLOW CHANNEL

DETAILS OF OVERFLOW WEIR AND CHANNELS, SHOWING ROCK SLOPES, CONCRETE JOINTS, AND RUBBLE MASONRY FACING.

After this portion has set, and when ordered, the temporory dam shall be entirely removed, the stream-flow turned through the completed openings and conduits and the remainder of the channel dammed off and the remaining lower portion of the gate house completed. The temporary dam shall then be entirely removed and the stream-flow allowed to pass through all the openings.

At this stage of the work floods will flow over the top of the masonry of the partially completed gate house but the ordinary flow may be controlled through the openings so as to permit the completion of the gate house superstructure, effluent conduit, blow-off, and drain. The masonry of the gate house shall be kept at least 25 feet below the lowest point of completed dam until the core-wall at its lowest point has reached elevation 265, at which time the gate house may be completed. The closure of the river bed and the construction of the lower portion of the gate house shall be done during a season of low stream flow.

SHEETING CORE WALL TRENCH.

The steel sheet piling shall be driven to a firm, tight bearing on the rock before excavating the trench below elevation 205. To insure accuracy in driving, the steel sheet piling shall be assembled and interlocked in a continuous vertical wall surrounding separate sections of approved size, into which the trench will be divided, not less than 50 piles being assembled in the wall as a unit for driving. These walls of piling shall be placed against and rigidly and accurately held in place by timber guide wales, one placed at the ground level and a second at a height above it not less than 1-3 the length of the shortest pile in the unit to be driven, each wale to be supported by a timber framework. When the wall has been driven to a sufficient depth to be firmly held by the ground the wales may be taken down or moved ahead and used again.

The steel sheet piles shall be driven by a steam or air pile driving hammer set centrally over them and held securely and vertically so that each blow shall be directed along centre of gravity of the piles. If required a driving head of cast-iron or steel shall be used on the top of the piles to prevent burring. All parts of the assembled wall shall be carried down as nearly simultaneously as is practicable, the cutting edge of any pile not being permitted to penetrate more than 5 feet deeper than the bottom of an adjacent pile.

Any boulder encountered which is large enough to prevent further progress by driving, shall be displaced by forcing water around it in large quantities under high pressure, through a 2½ inch casing sunk to the boulder by the wash or water-jet method, or if this fails blasting may be resorted to, using this casing as a means of placing explosives, or such other means as may be approved. Before firing any explosives all adjacent piles shall be withdrawn to a safe distance to prevent bending or injury to the cutting edge.

RESERVE SUPPLIES.

The contractor shall have at the site of the work at all times duplicates, in good condition, of such machines or parts of machines or appliances as are especially likely to wear rapidly, break, or be lost, so that the time lost on account of any part of the plant being out of order may be reduced to a minimum. For this purpose also he will be required to establish one or more suitable repair shops, at or very near the site of the work.

PUMPING AND WATER SUPPLY

As very deep excavation will be required for the core-wall trench where water is likely to be encountered and as there may be considerable overflow, and seepage from the river, which it is estimated may amount to 75,000 million gallons raised 1 foot, the contractor shall provide equipment for the removal and disposal of water from the excavations and other parts of the work, and for the removal of sufficient ground water adjacent to the excavation to assure the stability of the slopes.

For all plant, labor and materials connected with the removal of water from the core-wall and dam excavation and for pumping during the construction of the core-wall and dam and its appurtenances, the contractor shall receive the stipulated price per million gallons raised one foot. The measurement of head pumped against shall not include friction losses in pumps or piping, nor losses due to pumping in two stages, but the head shall be measured from a reasonable level in the sump from which pump or pumps engaged in exhausting the water in question takes its water to a reasonable elevation of the final discharge point.

PLANT WATER SUPPLY.

The contractor shall also provide at convenient points ample supplies of water of proper quality for all the operations required under this contract. This shall include the furnishing of pure water in acceptable quantities to the office of the engineer. A proper piping system shall be installed, maintained and extended from time to time to distribute water to the various portions of the work where it is needed. Wherever necessary the water shall be under sufficient pressure to give an effective stream from a nozzle for cleaning ledge rock or masonry on which masonry is to be built, for washing stones to be used in masonry, for sprinkling masonry, for wetting embankments, and for other purposes.

For fire protection of all the important temporary and permanent structures a water system shall be provided which will maintain a base-nozzle-pressure of 70 pounds when two 1⅛-inch fire nozzles are each discharging 200 gallons per minute. Hose connections and hose shall also be provided for fighting fires in these structures, and responsible persons shall be instructed as to the operation of such fire apparatus, so as to prevent or minimize loss of time from fire. Water casks or extinguishers of approved type shall be provided for minor structures.

SANITARY REQUIREMENTS.

Sanitary plumbing and approved methods of heating shall be installed. Rooms shall be acceptably ventilated and furnish complete protection from the weather. Single sleeping rooms shall be not less than 8 feet by 10 feet by 9 feet in size and all rooms shall have an adequate volume of air. All houses occupied by employes shall be thoroughly screened to exclude mosquitoes and flies. Cantonments shall, if ordered, be enclosed by satisfactory man-proof fences, with not more than two entrances. The entire ground within the limits of the various camps shall be thoroughly illuminated by electric arc lamps or other acceptable lights. This illumination shall be maintained from sundown to sunrise every night during the occupation of the camp, unless otherwise ordered.

Buildings for the sanitary necessities of all persons employed on the work, beginning with the first men employed to build camps or for other preliminary operations, shall be constructed and maintained without nuisance. The requirement for sanitaries in any locality shall be on a basis of one seat for each 20 persons, including both those on duty and those in camp off duty, who are dependent on the sanitaries in the locality in question; and they shall always be reasonably near the work. Sanitary conveniences shall be of the incinerator, water carriage, can or latrine type. The incinerator or tight-can type will be required within the watershed tributary to the reservoir. Where incinerators are required they shall be sufficient in number in any locality to permit a reasonable proportion to be out of service for incineration of their contents daily. Where the can system is permitted, cans shall be hauled away at least once a day and empty cans substituted therefor. No cans shall be emptied within the watershed. If latrines are permitted they shall be in accordance with the best practice in field sanitation and shall be burned out daily with crude oil. Drainage from kitchens, laundries, sinks, stables and other camp buildings, and any sewage, shall be satisfactorily collected and treated before discharge into any stream.

The contractor shall supply corrosive sublimate, quicklime, chlorinated lime, sulphur and other disinfectants and fumigants in ordered quantities, and perform the labor necessary to apply these materials as directed in disinfecting and fumigating camp and other buildings and disinfecting stables or grounds.

GARBAGE DISPOSAL.

Garbage, both liquid and solid, shall be promptly and satisfactorily removed from the buildings and immediately placed in approved tight receptacles of sufficient capacity for about one day's ordinary production. At least once in every twenty-four hours all such garbage shall be incinerated or otherwise thoroughly and satisfactorily disposed of.

The use of animals, except where especially permitted, will be forbidden within the reservoir wherever it is practicable to employ railroads, traction engines, cableways, power excavators or other mechanical devices to do the same work. Manure will not be permitted to accumulate anywhere.

MEDICAL AND SURGICAL PROVISIONS.

The contractor shall retain the services of an acceptable, qualified medical and surgical practitioner who shall have the supervision of the health of his employees, shall inspect their dwellings, the stables and the sanitaries as often as required, and shall supply medical attendance and medicine to the employees whenever needed.

The contractor shall provide ample general hospital buildings, supplies, facilities and attendance and must also provide the same for an isolation hospital for communicable diseases. All applicants for employment of the dam must pass a physical and medical examination and be free from any communicable disease.

CLASSIFICATION OF EARTH EXCAVATION.

Item 3 shall include all earth excavation, including top-soil and paper-mill sludge whether or not removed in advance of the other excavation, for the core-wall of the dam above elevation 205. Item 3 shall also include excavations for the core-wall of the dam ordered to be made below elevation 205 with unsupported side slopes flatter than 6 vertical on 1 horizontal.

Item 4 shall include all earth excavation for the core-wall of the dam in trenches with sides steeper than 6 vertical on 1 horizontal between the bottom of the excavations classified under Item 3 and elevation 150.

Item 5 shall include all earth excavation for the core-wall of the dam in trenches with sides steeper than 6 vertical on 1 horizontal, below elevation 150.

Item 6 shall include the removal of top-soil and paper-mill sludge not include in Item 3, and all earth excavations for the Midvale and Wolf Den dams, gate house, overflow weir, overflow and inlet channels, effluent conduit trench, substitute highway, driveways, fence, grading below the dam, and for all other purposes not included in Items 3, 4 and 5. Items 3, 4, 5 and 6 shall not include excavation from borrow pits, but the excavation of all such material will be paid for only under refill and embankment, Items 11 or 12 as classified.

The quantities to be paid for under Items 3 to 6 inclusive shall be the number of cubic yards of material measured as before excavation. All trenches in earth required to have approximately vertical sides not flatter than 6 vertical on 1 horizontal shall be measured as having vertical sides and the designated bottom widths.

In sheeted trenches with sides steeper than 6 vertical on 1 horizontal the bottom widths designated for payment will include an allowance as shown on the drawings of not more than 1 foot on each side of the net required space for structures or forms. All excavations in earth required to have side slopes flatter than 6 vertical on 1 horizontal shall be measured as having side slopes of 1 vertical on 1 horizontal unless flatter slopes are ordered; if flatter slopes are ordered, the excavations shall be measured in excavation to include the quantities actually removed from within the limits required.

FINANCIAL PROVISIONS.

The contractor shall give a bond in the full amount of the contract price. He shall pay to the Commission all expenses, loss and damages as determined by the Engineer, incurred in consequence of any defect, omission or mistake of the Contractor or his employees and shall pay as liquidated damages the sum of $250 per day for each and every day, except Sundays and legal holidays, that he shall be in default in completing the entire work to be done under this contract after November 30, 1923.

A bonus of $250 per day will be paid for each day, except Sundays and legal holidays, said contract is completed prior to December 1, 1923, it being understood and agreed, however, that a bonus will not be paid for more than a total of fifty days.

In addition to the liquidated damages herein provided for, there will be deducted from the moneys due under the contract, the wages, if any, paid to any inspector or inspectors necessarily employed in such work by the Commission for the number of days in excess of the time stated for the completion of the work.

Excavation With Power Scraper

The use of a slip scraper hauled and dumped by a simple, portable, power equipment and operated by two men saved $50 a day on the excavation for a large factory building.

The earth excavation for the Milwaukee Glove Works Company's factory at 10th and National avenues, Milwaukee, involved the removal of a large quantity of earth from street level to a few feet below, which was rapidly and satisfactorily excavated and loaded into wagons without hand labor. This was accomplished by the use of a hauling and elevating apparatus that was easily shifted from point to point, commanding the entire area of the excavation and elevating the spoil high enough to dump directly into motor trucks in the street, thus avoiding the necessity of having the trucks enter the pit and climb out again on a steep inclination, thereby considerably increasing their capacity and the rapidity of operations. The excavating and elevating of the earth was practically a continuous operation, except that it was limited by the ability of the trucks to remove the spoil as fast as provided, thus involving working time not due to any fault of the excavating apparatus.

POWER MACHINE.

An excavator and loader machine manufactured by the T. L. Company, and consisting essentially of an inclined steel frame plane about 25 feet long mounted with a hoisting engine on a truck, was installed with the rear end on the curb line and the upper part of the incline cantilevering over and clear of the top of a five-tone motor truck. The steel cable from the drum of its 18 h. p. heavy duty gas hoisting engine passed over a sheave at the upper end of the inclined plane, and over a second sheave mounted on a revolving frame pivoted to the inclined plane near the center point and normally perpendicular to it.

The cable was attached to the front of an ordinary slip scraper operated by one man. To the rear of the scraper was attached a tail line led through two sheaves attached at different points to an anchor chain fastened at the ends to steel stakes driven in the ground in such a position that the direction of the chain was approximately perpendicular to that of the hauling line. From the second sheave the tail line was led directly to the drum of the hoisting engine.

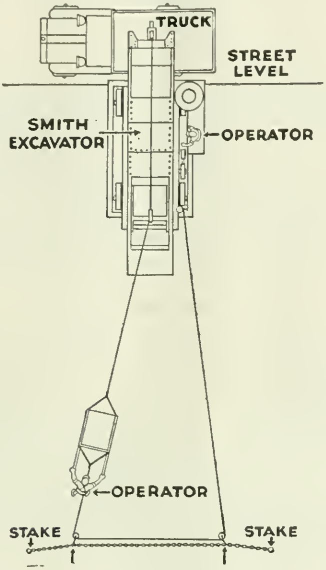
HAULING FILLED SCRAPER TO INCLINE AT SPEED OF 206 FEET PER MINUTE.

EXCAVATING AND LOADING.

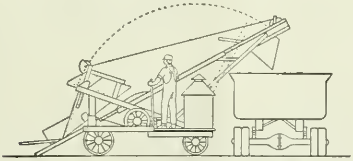
The tail line pulled the scraper backward to the required position for excavating at a sped of 228 feet per minute, and the hauling line pulled it forward at an excavating speed of 106 feet per minute. When the filled scraper, hauled at a speed of 106 feet per minute, reached the inclined plane, it was continuously pulled up on it, ascending smoothly on the sheet iron apron to a point where there was a hump in the apron under the pivoted frame, and the latter was automatically unlocked by the scraper so that the continued tension on the hauling line revolved the frame upwards, elevating the scraper above the plane and carrying it forward to the end of the cantilever, where it was automatically reversed, dumping its contents into the waiting trucks. The machine operator then pulled the reverse lever, causing the pivoted frame to swing back and down and lock, and the tail line to haul the scraper back

PIVOTED FRAME RAISING SCRAPER TO DUMPING POSITION.

to excavating position at a speed of 228 feet per minute. Only two men were required to operate the scraper and load the trucks. Whenever it was necessary to shift the point of excavation, the forward tail line sheave was very quickly reconnected to the anchor chain at a different point, and, when the full area commanded by the length of the anchor chain was excavated, it was very easy to drive the stakes in new positions and shift the chain for continued operations.



ARRANGEMENT OF EXCAVATOR OPERATING LINES, SCRAPER AND ANCHOR LINE.



SIDE ELEVATION OF EXCAVATOR MACHINE.

Although the spoil was hauled a long distance from the factory there were only two trucks available for the work. Each of these was loaded in about six minutes, after which there was a wait of 15 to 20 minutes for the next truck, but even under these circumstances the excavation averaged 150 yards per eight-hour day, and the contractor, Gerry Wolf, made an estimated saving of $50 per day over the cost of doing the work without the excavating machine.

Railway Freight Movement

In the United States there are about 2,452,000 freight cars now in use. These are rolling in trains loaded and empty only 9.03 per cent of the time. They average 11.29 per cent time loading and 11.29 per cent being unloaded, if every car is released before demurrage starts. The balance of 68.39 per cent is waste time, due to repairs, switching, and unnecessary delays. One hour saved each day for each car would be 2,452,000 car-hours per day, equivalent to over 102,000 additional cars at no delay or extra cost.

March Building Operations

The total amount of contracts awarded during March in the territory east of the Missouri and north of the Ohio rivers, according to statistics compiled by the F. W. Dodge Company, showed a great increase over the figures for January and February, and was, in fact, greater than the figure for any month in 1919. The total amount for March was $327,897,000, as against $235,848,000 for January, and $216,663,000 for February

These figures give $780,408.000 as the total for the first quarter of 1920. Normally the first three months of the year account for about 20% of the year's total of work started. In the first quarter of 1919 contracts awarded amounted to $275,555,000. Of the total for the first three months of the year, $267,193,000, or 34%, was for industrial buildings; $150,651,000, or 19%, was for residential buildings; and $146,973,000, or 19%, for public works and utilities. This shows that the work which has been held up is in the residential group; that is, the smaller building operations. Normally, this group accounts for about 30% of the total, and at the present time, in view of existing needs, it should be about 40% of the total.

Although contracts have been awarded to the amount of 780 millions of dollars there is still a vast amount of work being held up for more favorable conditions. In the first quarter of 1920 contemplated and projected work of all kinds was reported by the F. W. Dodge Company to the amount of $1,700,000,000. Of the contemplated work, public work and utilities amount to $363,802.000 or 21% of the total; industrial buildings amount to $355,073,000, or 21% of the total; and residential buildings amount to $343,173,000, or 20% of the total.

Omaha Municipal Gas Plant

Omaha, Nebraska, which has a population of 200,000, is the largest municipality in this country to undertake the operation of a gas plant. On March 20, the city commissioners voted to take over the works of the private gas company at a price of $4,500,000 and to operate them; further voting $1,000,000 as working capital for improvements and extensions.

In November, 1907, the city voted at a special election against issuing $3,500,000 in bonds for acquiring the gas plant. In May, 1918, however, the proposition to acquire the gas plant by eminent domain through the Condemnation Court was carried and an appraisal of the plant was made by Burns & McDonnell representing the city and by W. H. Taylor, H. C. Anderson and William A. Baehr representing the company. The value placed upon the property by the city's appraisers was $3,760,000, while the three appraisals made for the company varied from $5,518,000 to $6,281,000. These figures were intended to represent the depreciated value of the property, including going value. Early in February, 1920, the Condemnation Court rendered a decision fixing $4,500,000 as the value of the property and the action of the city commissioners was taken upon the basis of this award.

The plant will be operated by the municipality under a bi-partisan board of directors with a manager in charge of the property, the board being the same that now so successfully operates the municipal water plant. It is not anticipated that gas rates will be increased under city management, although such rates have been increased by many of the privately owned gas plants throughout the country.

Cost of Unimproved Roads

In a recent letter written by S. M. Williams, chairman, Federal Highway Council, the statement is made that in this country the waste due to unimproved roads is more than $500,00,000 per year, a sum which conclusively demonstrates the immediate necessity of highways on which heavier loads can be hauled for longer distances, at greater speed and with reduced power than is now possible.

It is estimated that the time wasted on account of difficult highway hauling due to poor roads is equal to that of an army of 250,000 men who should be released for active work on increased production. He also points out that improvement of the 85 per cent. of traffic that is carried on public highways is fully as important as that on the 15 per cent. carried by railroads. Such a program in no way interferes with one of thorough economy, the latter consisting not in the spending of no money, but in spending money most efficiently.

A graphic illustration of the high cost of bad roads has recently been cited in the case of a farmer in Sullivan County, Tennessee, who had to make four three-day trips with a two horse team to haul a ton of barbed wire 23 miles at a total cost of about $36.00. After a hard road had been built he was able to haul one ton in two days at a cost of $6.00 allowing $3.00 per day for the team and driver, a sum which would have to be considerably increased today, thus making the saving proportionately larger.

Highway Notes

The Galveston, Texas, Board of Engineers has completed its survey and submitted a report recommending the expenditure of $6,750,000 for 11,000,000 yards of filling, for repaving, minor contingencies and engineering, $628,000 for extensions of present sea-wall, $175,000 for the construction of higher new sea-wall, $9,500,000 for raising the grade of all railroads and freight handling plants and other improvements.

Good roads has been made a plank in the political platform of Cameron Morrison, candidate for governor of North Carolina. He declares himself "In favor of a robust good road policy—which will result in the speedy construction of a great system of highways worthy of North Carolina." He proposes to link together a dozen isolated counties in the northwest part of the state that comprise one of the richest and greatest sections of the state to the railroad system.

It is reported to have been seriously proposed to solve the London traffic problem by a great subterranean system of motor thoroughfares, including boulevards, to connect the heart of the city, 30 miles wide, with the outer districts and permit automobiles to escape the congestion of the other vehicular traffic. Such an idea seems to be working backwards from the plan of providing freight subways under the streets, as has been accomplished with some success in Chicago.

Iowa Highway Program

In the state of Iowa about 1,200 miles of new roads have been surveyed and plans and specifications completed and approved. The mileage includes 321 miles of paving and 207 miles of gravel, the balance being earth road grading. In addition, there are now under way contracts for 231 miles of road and 26 counties have voted for hard surfacing and 13 counties have voted against it. The total amount now available for road construction in the state is about $33,000,000 and the immediate problem is to get material, contractors and labor to execute the work.

Wanted, An Altruistic Contractor

In Douglas County, Nebraska, litigation is expected because bonds for county highways were voted on the strength of a pledge by the County Board that the roads would be surfaced with brick, notwithstanding which less than one-third of the contracts already let call for brick construction.

A strong appeal has been made against the substitution of bithulithic compounds for vitrified brick and the matter will probably be litigated unless the innocent contractor, who was low bidder on both the brick and bitulithic pavements, will give up the bitulithic contract and pocket the loss for the benefit of the public.

To Diminish Tearing Up Pavement

The recent decision of a court in Cincinnati, establishes a precedent for all Ohio municipalities to force taxpayers and corporations to put all necessary improvement on the streets before the latter are repaved, and if they refuse to do so, authorizing the city to make the improvements and charge the cost of the same back to the taxpayers or corporations. The case will be appealed and is expected that the final decision of the Supreme Court will be handed down promptly.

The new paving now in progress or already ordered for Fort Worth, Texas, totals $2,500,000 and even with plenty of labor and materials, cannot be completed within less than one year making it is claimed, the best paved city in the southwest.

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Just and Acceptable Construction Requirements

The Wanaque Dam described in this issue is a fair example of important public work involving ordinary features of heavy construction similar to those likely to be encountered almost anywhere in this country on municipal goverment, or corporation projects of magnitude. In preparing these admirable specifications and contracts, which are partially excerpted in our article, the chief engineer, M. R. Sherrerd has revised and improved some of the best specifications of the kind previously issued and has added to them clauses well calculated to define the important requisites for a first-class job, making them simple enough to be easily understood and followed, and avoiding the necessity of interpretations and providing fair treatment and consideration for the contractor without in any way impairing the excellence of the work required or neglecting the interest of the owner.

Special pains have been taken to determine obscure conditions and probabilities and to foresee difficulties and resources that may be developed during the work so that the contractor can plan to the best advantage, although still acting wholly on his own responsibility, aided by the intelligent preliminary investigations of the designer.

By incorporating in the contract definite requirements regarding labor, housing, sanitary and medical conditions all bidders are compelled to conform to high-class practice, and the interest of the state, of the laborer and of the owner are protected without deteriment to the contractor.

Special attention is called to unusual features and requirements of the work by a note emphasizing the importance of the core-wall trench, the river regulation, the schedule of operations to secure rapid progress and the unusual features of waterproofing and price adjustment.

The rational classification of earth excavation in items defined by the working conditions, as well as by the character of the material, enables a fair price to both the owner and contractor to be secured for each unit. This price is accurately defined, and is directly proportioned to the actual cost of the work, and shows consideration for the contractor, who, although unable to make a great unearned profit, is protected by it against losses due to great variations of anticipated quantities.

The customary penalty for delayed completion of the work is, as it always should be, offset by an equal bonus for earlier completion, which is fair to both parties.

The unusual provision of a unit price for pumping out foundation pits during construction is justified by the exceptional depth and expected condition of the core-wall trench that would otherwise compel the contractor to bid unreasonably high to protect himself.

The tentative requirement that the bidder shall possess experience, equipment and finances adequate to the work is just and reasonable, and should certainly be enforced in this and all other similar work of magnitude and difficulty.

A very important feature of the specifications is the provision for varying the price to the contractor in accordance with large variations in the cost of labor, which is such an important factor of the work that, in these times of great instability, it would probably deter conservative contractors from bidding except on a cost-plus basis or at prohibitively high figures. Contractors will appreciate these specifications and the spirit in which they are prepared, and they should go far to improve the quality, rapidity, and economy of the work.

Improving Labor Conditions

Increase the efficiency of labor by classification, selection and training. Fight to a finish for open shops. Discharge worthless and seditious employees at the drop of the hat. Make labor unions incorporate, provide and enforce heavy legal and criminal penalties for breach of contract, violence, intimidation and conspiracy. Simplify construction plans, adopt standard plant and methods, work to pre-determined schedules, use materials suited to practical requirements, not necessarily superfine, use the maximum of high-class labor saving machinery. Then, and not before, will this land be honest, safe and prosperous.

Poor Policy and Precedent

The announcement that the Erie and Oswego canals are to be operated on a schedule of only 8 hours per day, indicates either that they have far too little traffic, that they are governed by a deplorably parsimonious policy or that they are being handled for political effect, a trio of evils which is hard to choose between.

In this time of high freight tariff and congested transportation, the canals ought to be operated to the limit of their capacity, and at all times their service during the short navigation season, in this case only from May 1 to Nov. 1 should be continuous especially since it is of a nature very slightly affected by day or night conditions. If with a moderate amount of business eight hours of traffic paid the charges, the other sixteen hours would be pure velvet on the investment, so that eliminating them is the worst kind of penny-wise, pound-foolish policy provided there is or can be secured sufficient traffic for continuous service.

On the other hand, if revenue is limited or traffic in any way discouraged to serve political ends or at the behest of labor unions or any kind of profiteering influences, it is especially corrupt.

The only excuse for part-time work on this valuable property is the impossibility of getting sufficient business and if that be the case, it should apparently be quickly remedied.

Especially at the present time when increased production and economy are vital necessities, the operation at part-time of any important industrial or commercial system than can or should be operated continuously, is both foolish and wrong. The fact that it is a public utility controlled by public officers and superior to limitations and restrictions of private enterprise makes mismanagement wholly unnecessary and the example that it affords of inefficiency, wastefulness, and injustice encourages the conscienceless wastrels, profiteers and the turbulent and irresponsible elements of Bolsheviks, Socialist and Communist tendencies.

It is therefore doubly regrettable both for policy and precedent to have any failure of the most abundant, efficient, and economical service that public utilities are capable of, especially in transportation.

Uniformity for Concrete Sewers

A desirable step for the improvement of type, details, materials and construction of concrete sewers, has been taken by the American Concrete Institute in presenting through its committee of experts a standard specification for the construction of concrete sewers, accompanied by rules recommended for their design, the latter being published in full on page 336. These standards are especially acceptable for their simplicity and brevity. They do not attempt unnecessary refinement; they are admirable not only for the clear and positive restrictions in vital points where there can be no conflict of opinion on the practice involved, but also for the brief and authoritative rules that do not require demonstration or explanation. They possess at least an equal virtue in the omission of special cases, elaborate conditions, irregular work, complicated details, minor variations and exceptions that so often burden efforts to accomplish the impossible in providing for every sort of contingency and specifically covering an unknown field.

These rules simply indicate the more important general considerations that are applicable to all concrete sewer construction and which, if adopted, will lead to a much greater simplicity and uniformity, making design, estimates and construction more rapid, satisfactory and efficient, and will tend to eliminate disputes and misunderstandings between owners, engineers and contractors and to generally improve current practice.

These rules apply chiefly to the regular cross-section of the sewer under ordinary, normal conditions, and are not involved with special requirements, conditions or difficulties that, to be successfully met, must always be carefully studied and supervised by experienced engineers.

The rules do not in any manner make "Every man his own engineer" but they do afford safe minimum provisions that establish standards which may be confidently adopted for ordinary work and accepted in cases of quick decision where there is little time for investigation, with the strong probability that, even if there may be slight excesses over the absolutely necessary requirements, the uniformity and simplicity will justify them and result in total costs about as low as or lower than would be secured by hair-splitting refinements.

The rules govern the principal dimensions of the structures, proportions of concrete and reinforcement, maximum working stresses in concrete and steel, calculation of stresses by standard method, and the finish of the invert; data which, with the specifications themselves, provide for durable and reliable construction.

It is be regretted that the brevity of the rules has prevented their including more reference to foundations in very soft, wet or treacherous ground and protection against exterior forces, as at road crossings.

Municipal Bond Sales

In March of last year the output of new bonds was $57,000,000 as compared with $21,000,000 and $24,000,000 in January and February, respectively, and with $26,000,000 in March of 1918. In March of this year, the sale dropped to less than $51,000,000, which, however, is considerably higher than any year since 1915, with the exception of last year. The falling off is more evident, however, when compared with the $87,000,000 in January, 1920, and $89,000,000 in December, 1919.

According to the Bond Buyer, "the best cities in the country are now having trouble in financing improvements with five per cent bonds, whereas, a year ago that rate of interest was sufficient to assure the sale of any reasonable amount of bonds at a substantial premium. While most cities are permitted by law to pay as high as 6 per cent, such a rate is so unusual that the tendency is to postpone the making of improvements and the issuance of bonds when it is found that the market demands over 5 per cent." In fact, we have learned of at least one city which has so far been unable to dispose of 6 per cent bonds at par and is postponing work in consequence.

To a considerable extent, this will have a much less effect upon state and county highway work than upon city work, for the reason that there is already available a large amount of funds for such work, and in most of the states the income derived from automobiles is available for highway construction. It seems probable, therefore, that road work will be little interfered with by bond market conditions, but will be limited by the high cost and scarcity of materials and labor and difficulties in transportation.

Bending Reinforcement Bars

A large quantity of ⅝-inch twisted reinforcement bars for a syphon near Caldwell, Idaho, were rapidly and economically bent by an ordinary tire bender with the rolls set vertical and operated by power from the concrete mixer. Two or three bars could be bent simultaneously, six or eight being bent per minute.

Concrete Sewer Standard Specifications

The Committee on Concrete Sewers, appointed by the American Concrete Institute, presented at the 1920 convention a report submitting standard specifications for the construction of concrete pipe, arch and slab sewers (to be excerpted in "Public Works"), and recommended that the sewers would be designed in accordance with following standards. Comprehensive and detailed requirements proposed for adoption as standard include features commonly used in advanced structure practice and give special attention to invert construction; arch forms; backfilling; manufacture, testing and laying of reinforced concrete pipe; and comprehensive rules for concrete sewer design.

COMMITTEE'S REPORT.

The American Concrete Institute's Committee on Concrete Sewers recommended to the Chicago Convention, February 16-18, the adoption as standard of specifications for construction and design which are in revision of those submitted by the committee at the 1919 meeting.

As instructed by the last meeting, the committee has, as far as possible, eliminated the word "Contractor" from these specifications. If this matter had not come as an instruction from the meeting, it appears that the committee should have preferred to have retained the so-called contract clauses, as in many cases they seem to be almost integral parts of necessary specifications. The committee does not, however, consider their inclusion as of vital importance.

The committee accepted the amendments as to speed of mixers which were made on the floor of the 1919 meeting, but voiced a feeling that standard mixer speeds can be somewhat slowed down with resultant advantage to the product.

The committee does not concur in the amendment from the floor of the 1919 meeting introducing blast furnace slag as a good coarse aggregate. This material is, however, included in the accompanying specifications, and is to be considered as having been included by the 1919 meeting without the approval of the committee. The committee has no data on which to approve or disapprove of this material in sewer construction.

In the matter of quality of crushed stone aggregate, the committee substituted a French coefficient of wear of 8 for the coefficient of hardness of 16 formerly recommended. This will not materially change the character of stone permitted, but the change is made in order to eliminate the recollection of the discussion on the floor of the 1919 meeting, in which many of the members apparently mistook the coefficient of hardness for the French coefficient of wear.

The French coefficient of wear is fully described in bulletins 347 and 370 of the United States Department of Agriculture, and the test on which it is based has been standardized by the American Society for Testing Materials. The committee consisted of W. W. Horner (chairman), Arthur S. Bent, Alfred H. Hartman, W. S. Lea, Frank A. Marston, Langdon Pearse, Coleman Meriwether, W. R. Harris, A. J. R. Curtis and W. K. Hatt.

Rules for Concrete Sewer Design

1. Concrete sewers without reinforcement are approved for sizes between 30 and 60 inches mean diameter. Plain concrete sewers between these sizes are to be used only in rock or hard soils. It is recommended that the minimum thickness for a diameter of 36 inches or under should be 5 inches, and for a 5-foot diameter 7 inches, with intermediate sizes in proportion. These thicknesses are to be taken as a minimum for circular sewers and used only under favorable conditions.

CONCRETE PIPE SEWERS.

2. (a) Steel Reinforcement.—The reinforcement for circular pipe shall consist of one or two rings of steel wire fabric or rods of the areas shown in the accompanying table. Special methods of reinforcement will be permitted if the requirements of Article 7 as to crushing strength are fulfilled.

(b) Thickness.—The thickness of pipe walls shall be as set forth in the following table, but thinner walls may be used provided the amount of steel reinforcement is increased to give sufficient strength to withstand the crushing loads specified in Article 7 of these specifications.

REINFORCED CONCRETE MONOLITHIC SEWERS.

3. All sewers near the surface and subject to moving loads or vibration should be reinforced. For sewers of 6 feet or less in diameter it is recommended that the reinforcement be half of 1 per

cent placed near the inside at the crown, and near the outside at the springing lines.

If it appears at all possible that the horizontal pressures on the sewer might be large, reinforce for reverse stresses.

4. It is recommended that for all sewers greater than 6 feet in diameter several possible types of loading be assumed and stresses be calculated on the elastic arch theory. (The methods are indicated in Tourneaure and Maurer's "Principles of Reinforced Concrete," or in Metcalf and Eddy's "American Sewerage Practice," Volume 1.)

5. It is also suggested that in sewers of greater than 6 feet in diameter it may be found economical to adopt a section having a comparatively flat bottom and an arch with or without intermediate side walls.

6. The minimum thickness of concrete in sections of this type should be 8 inches. This is recommended as a factor of safety against poor placing and also to secure waterproof structures.

DIMENSIONS AND REINFOREMENT FOR CIRCULAR SEWERS.

Size, inches.	Minimum Thickness of Shell, inches.	Cross Sectional Area of Steel, lin. ft. of Shell.
24	3	1 concentric ring of .058
27	3	" " " " .068
30	3½	" " " " .080
33	4	" " " " .107
36	4	" " " " .146
39	4	" " " " .146
42	4½	" " " " .153
48	5	2 " rings " .107
54	5½	" " " " .126
60	6	" " " " .146
66	6½	" " " " .168
72	7	" " " " .180
84	8	" " " " .208
96	9	" " " " .245

PROPORTIONS OF CONCRETE.

7. The specifications submitted provide for three classes of concrete. It is recommended that all arches be built of Class "A"* concrete, and that the inverts be of Class "A" concrete, except in rock or very hard soils, where Class "B" concrete may be used. Class "B" concrete is not recommended for use in the sewer proper.

8. For reinforced work in bad ground the designer should provide for a raft of Class "C" concrete of from 4 to 6 inches in depth, which is to be allowed to set before the reinforced structure is started. This is advisable to facilitate good workmanship and particularly to prevent contamination of the concrete around the reinforcement by mud or sand.

REINFORCEMENT.

9. The distance from the face of reinforcing steel tion of 250,000. The rainfall on this watershed to the face of the concrete in monolithic sewers should be not less than 2 inches.

10. In all important work specify that the reinforcement shall be held in place with steel chairs or holders and wire tires.

11. In determining dimensions of concrete and reinforcement the following working stresses should be the maximum used:

(a) The maximum working stress in the steel where structural grade is used should be not more than 12,000 pounds, and for intermediate or hard grades, or for cold twisted bars, 16,000 pounds per square inch.

The maximum working stress in rail steel should not exceed 16,000 pounds per square inch.

CONCRETE STRESSES.

(b) The maximum working stresses in concrete are based on the report of the Joint Committee on Concrete and Reinforced Concrete, and are about 25 per cent less than the stresses there recommended.

Aggregate.	Class A.	Class B.	Class C.
Granite or trap rock	550	450	350
Gravel or hard limestone	500	400	325
Soft limestone or sandstone (if permitted)	375	300	250

WORKING STRESSES IN POUNDS PER SQUARE INCH.

Soft limestone and sandstones are prohibited if the accompanying specification is rigidly carried out.

These stresses should be further reduced where construction conditions are likely to be very unfavorable to good workmanship, as in very wet or very deep trenches.

12. Attention is called to the fact that with sewers having comparatively flat inverts, careful consideration must be given to the distribution of load across the invert. Where soils are likely to be compressible, the weight should be taken as uniformly distributed. The stresses in such inverts should be carefully analyzed, as they are generally more severe than the other parts of the sewer.

It will generally be advisable to provide alternate details of the invert for use in rock cuts, when resting on rock or nearly incompressible soils and for soft or wet ground.

13. Accompanying specifications for monolithic work provide for either a granolithic finish on the invert or for a lining of concrete block, brick or tile. The use of the separate lining should be considered as an additional factor of safety where unsatisfactory construction conditions are likely to affect adversely the quality of workmanship and the strength or density of the finished invert concrete.

Concrete Sewer Invert Construction

The standard specifications recommended by the committee of the American Concrete Institute provide that:

Section 45. On all sections having a comparatively flat invert, the complete invert shall first be built, while on all circular sections a center strip of not less than one-fourth circumference shall be built. The invert of center strip shall be placed in sections of not over 16 feet where the surface is to be finished with end guides and a longitudinal straight edge, and not more than twenty feet if a separate lining of vitrified brick, tile or concrete block is to be provided.

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*Class "A" Concrete—1 bag of Portland cement, 2 cubic feet fine aggregate, 4 cubic feet coarse aggregate. Class "B" Concrete—1 bag Portland cement, 2½ cubic feet fine aggregate, 5 cubic feet coarse aggregate. Class "C" Concrete—1 bag Portland cement, 3 cubic feet fine aggregate, 6 cubic feet coarse aggregate.

Section 46. A granolithic finish shall be applied to the fresh concrete as soon as the condition of its surface will permit. This finish shall consist of a mixture of one part of cement to two parts of granite, or other hard rock chips, graded from ⅛ inch to ½ inch in size, and shall be laid 1½ inches thick. The upper surface shall be formed by means of screeds and shall be floated and troweled to a smooth surface. As soon as this surface is dry enough to receive it, a dry mixture of two parts of cement and one part of sand, free from crusher dust and particles larger than ⅛ inch shall be sprinkled over it and then the surface shall be floated and troweled. This treatment shall be repeated at least once, and where the proportion of very fine material in the aggregate necessitates it, a total of three dryer coats shall be applied. Where the placing of the dryer coat must be deferred until the day following the pouring of the concrete invert, the concrete shall be first moistened and covered with neat cement, which shall be thoroughly broomed into the concrete in the form of a thick paste.

*Section 47.** Where required, the inverts shall be lined with concrete block, tile, or vitrified brick, as shown on the plans.

47.1. The concrete bottom shall be accurately shaped up to a line one-half inch below the bottom of the lining and allowed to set before the lining is laid. A mixture made of one part of Portland cement and three parts of sand, without the addition of water, shall be spread on the finished surface to the depth required to bring the block or brick to the required grade. The lining units shall be laid in straight lines and all joints broken. After being laid it shall be brought to solid bearing by a 300 to 500 -pound-hand roller, or by tamping, and the joints shall be grouted with 1:2 mortar and the surface brushed until every joint is filled.

(To be concluded)

Enormous Hydro-Electric Plant Possible

The construction of a hydro-electric plant, larger than any now existing in the world, will become possible if Congress passes the water power leasing bill now pending. In this event it is expected that the General Electric Company or one of its subsidiaries will get the lease of the Priest Rapid site on the Columbia River where there can be developed an hydraulic plant with a maximum capacity of 700,000 h. p. in high water, and 400,000 h. p. in low water. This will involve the construction of a dam 85 feet high across the Columbia River below which all the land may come under a gravity ditch.

Drainage for Houston

The report of J. C. McGea, city engineer of Houston, shows that only 3,290 acres of the 21,247 acres included within the city limits are served by underground drainage, and that the drained area requires 10 per cent more drains to make the system effective.

Drains are especially needed for 6,515 acres of developed territory and the report recommends the creation of a system including the entire city to be constructed at an approximate cost of $9,171,000 which would be fully justified by its economy and efficiency.

Tractor Use in Providence

The city of Providence, Rhode Island, owns and uses a tractor to which it attaches an asphalt distributor of 1,500 gallons capacity. It also uses a 6-yard, 10-ton trailer body for the distribution of other paving materials. City Engineer M. H. Bronsdon reports that both of these have given very good satisfaction. No ton-mile costs are available at this time which would furnish definite figures concerning operation of the tractor and trailers.

Mr. Bronsdon states that: "Inasmuch as street construction and street repair performed by municipalities extend over only six months of each year, it is desirable to perform as much of this work as possible in the early part of the year, and it is also desirable to use motor-driven apparatus to obtain the greatest capacity. Horse-drawn vehicles are satisfactory on short hauls, but are certainly too slow for hauls of one mile or greater. Also it is more advantageous in constructing new streets by the penetration method to keep horses off the broken stone during construction after the stone has been rolled.

"It is my belief, however, that while building roads by the penetration method, lighter loads should be carried over rolled stone, before the penetration of asphalt takes place, than results by the use of a 1,500-gallon tank distributor drawn by a tractor. It would be more satisfactory, I believe, to have two 4-wheeled trucks, each with tanks of approximately 800 gallons, in order to carry on work at two locations and with smaller gangs. It is also more difficult to find operators capable of handling a tractor and trailer than operators to handle 4-wheeled trucks or distributors."

Municipally Owned Asphalt Plants

The following list of municipally owned asphalt plants in the United States, Canada, and some other countries has been furnished by Charles A. Mullen, of Milton Hersey Co., of Winnipeg. It is presumed that this list is complete to date:

Atlanta, Georgia.
Bayonne, New Jersey.
Bluffton, Indiana.
Boise, Idaho.
Brooklyn, New York.
Buenos Aires, Argentina.
Camden, New Jersey.
Charlottetown, P. E. I.
Chatham, Ontario.
Chicago, Illinois.
Chicago, Illinois, Lincoln Park.
Cincinnati, Ohio.
Cleveland, Ohio.
Columbus, Ohio.
Dayton, Ohio.
Denver, Colorado.
Detroit, Michigan.
Duluth, Minnesota.
Elmira, New York.
Erie, Pennsylvania.
Fall River, Massachusetts.

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* This construction is particularly applicable to sewers having comparatively flat inverts, and is more difficult to carry out with circular sewers.

Fayette Co., Kentucky.
Flint, Michigan.
Fort Wayne, Indiana.
Fort Worth, Texas.
French Government.
Hamilton, Ontario.
Harrisburg, Pa.
Honolulu, Hawaiian Islands.
Indianapolis, Indiana.
Kansas City, Missouri.
Kingston, Ontario.
Lansing, Michigan.
Lima, Peru.
Lincoln Park Commission, Chicago, Illinois.
Little Rock, Arkansas.
London, Ontario.
Los Angeles, California.
Manchester, New Hampshire, Vermont.
Manhattan Borough, New York City.
Memphis, Tennessee.
Milwaukee, Wisconsin.
Montreal, Quebec (4 plants).
Munro City, Kentucky.
Munroe County, Michigan.
Nashville, Tennessee.
Newark, New Jersey.
New Bedford, Massachusetts.
New Orleans, Louisiana.
New York City, Brooklyn.
New York City, Manhattan.
New York City, Queens.
Niagara Falls, New York.
Norfolk, Virginia.
Oklahoma City, Oklahoma.
Northampton, Massachusetts.
Omaha, Nebraska.
Ottawa, Ontario.
Pawtucket, Rhode Island.
Pittsburgh, Pennsylvania.
Portland, Oregon.
Portsmouth, Virginia.
Queens Borough, New York City.
Reading, Pennsylvania.
Saint Louis, Missouri.
Saint Paul, Minnesota.
Saginaw, Michigan.
San Francisco, California.
Schenectady, New York.
Scranton, Pennsylvania.
Seattle, Washington.
Sherbrooke, Quebec.
Shreveport, Louisiana.
Spokane, Washington.
Springfield, Massachusetts.
Superior, Wisconsin.
Syracuse, New York.
Topeka, Kansas.
Toledo, Ohio.
Toronto, Ontario.
Trenton, New Jersey.
United States Government (12 plants).
Victoria, British Columbia.
Washington, District Columbia.
Wilmington, Delaware.
Winnipeg, Manitoba.
Worcester, Massachusetts.
Youngstown, Ohio.

A Profitable Municipal Water System

The city of Jonesboro, Arkansas, has a unique and enviable record for having installed and maintained a public water and light system that has very nearly paid for itself with total profits aggregating $383,540 during 13 years of municipal ownership with an invested capital of $133,604. Besides yielding an average net profit of $29.503 a year, the system is paying for a $100.000-sewer system and the consumers are getting the lowest water and light rates of any city in the state. Every unit in the plant is duplicated so as to keep one in reserve for emergency. The estimated present worth of the plant is $500,000. The secretary of the city board of improvements publishes an acknowledgment to Manager J. F. Christy for his efficiency and farsightedness.

Pittsburgh Water and Typhoid

Before the city of Pittsburgh had filtered water, the death rate from typhoid fever was approximately 130 per 100,000 population annually, but since the filtration of the water, it has been reduced until last year it was 4 per 100,000, thus showing that in the 13 years since the filtration plant was put in operation, the number of deaths has been reduced 31 times, practically eliminating it. At this rate, and assuming the value of a human life at $3,000, the cost of the plant is saved every 18 months. In 1919 the plant purified more than 44,000,000,000 gallons of water.

Power for a City Planning Commission

There has recently been submitted to the Mayor of Syracuse, N. Y., a bill creating a city planning commission to consist of four appointed members besides the city engineer, corporation counsel and commissioner of public safety, ex-officio members, which are to have their present powers of controlling the opening of streets enlarged by the jurisdiction over monuments in parks and public places, street lighting, decoration of the streets for public celebrations, and, most important of all, the power to describe zones limiting manufacturing and merchandising and thus becoming an administrative and legislative agency rather than a merely advisory agency with the majority of its membership directly responsible to the Mayor and having its decisions subject to review by the common council which may reverse them by two-third vote.

Extensions of Federal Road Aid in West Urged

Extension of Federal aid in road building from the equal federal and state appropriations to a ratio basis determined by the acreage of non-taxable Government lands has been strongly urged on Congress by delegates appointed by the governors of fourteen public land states west of the Mississippi and by Governor Riggs of Alaska.

City officials of Akron are considering a proposal to either have the city take over and operate the street car lines in that city, or have Akron business men form a company for this purpose. According to the business men, they believe it would be possible to raise sufficient money to purchase the lines valued at approximately $4,500,000.

Cleveland is again giving consideration to a plan for a freight subway to connect the Lake Erie shore at the eastern section of the city to the southern industrial district and co-operate with a ferry line to Canada by which loaded freight cars could be transferred for Canadian points.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

VERIFICATION, POSTING AND FILING OF NOTICE DISCLAIMING LIEN LIABILITY.

(Cal.App.) Code Civ. Proc. § 1192, as amended by St. 1911, p. 1313, providing that the owner of premises may relieve himself from liability for work, labor, or materials furnished upon the same by posting notice in writing to that effect in a conspicuous place on the property and filing a verified copy in the office of the county clerk, must be strictly complied with to relieve an owner from responsibility for labor done or materials furnished, etc.—Pasqualetti v. Hilson, 185 P. 693.

Where the owner of premises posted a written notice that he would not be liable for work, labor or materials furnished thereon, and filed for record a copy of such notice containing his acknowledgment thereof before a notary public, there was not a sufficient compliance with Code Civ. Proc. Sec. 1192, as amended by St. 1911, p. 1313, requiring copy of such notice to be verified, to free the owner from liability, for an acknowledgment before a notary is not equivalent to a verification.—Id.

Where the owner of premises had posted a written notice in compliance with Code Civ. Proc. Sec. 1192, as amended by St. 1911, p. 1313, that he would not be responsible for work, labor or materials furnished upon the premises, but failed to comply with the exact requirements of the section, as to recording of verified copy of such notice, he is liable to persons furnishing labor and materials at the request of lessees of the premises, though such persons had actual knowledge of the posting of the notice of nonliability.—Id.

SUBCONTRACTORS' AND CONTRACTORS' WORKMEN AND MATERIALMEN.

(Ind.) A direct and positive covenant in principal contract against right of any one to lien precludes all, who work under, or furnish materials to, the principal contractor, from having a lien.—Baldwin Locomotive Works v. Edward Hines Lumber Co., 125 N. E. 400.

Subcontractors and materialmen are bound to know what is in the principal contract, and so that it contains a direct and positive covenant against liens.—Id.

Provision in building contract, permitting the owner to retain payment from the principal contractor till liens are discharged, is not sufficient to overthrow and abrogate the direct and positive covenant therein against liens.—Id.

(Tex. Civ. App.) Where no installment of the price of the work was due the contractor for work done when a materialman or a mechanic gave notice to the owner's agents for the purpose of receiving such notice, the materialman or mechanic secured no right against the owner or the property, through the giving of such notice, accompanied by presentation of an order for payment from the contractor, claimed to operate as an assignment.—Leeper-Curd Lumber Co. v. Barbuzza, 216 S. W. 216. (Wis.) A subcontractor on a building which has perfected its lien for work, labor, and material furnished, the greater part before the date of the contractor's assignment to a bank of funds or payments due, has a prior and superior right to payment from such funds over that of the bank.—Neil & Co. v. Sedlachek, 175 N. W. 89.

A contractor's bondsman, which has no subsisting claim for moneys previously paid by it on account of its liability as surety to release any lien on the owner's property or for any claims paid by it constituting a superior and prior claim to that of a bank as creditor of the contractor on the funds received on the building contract, has no superior equitable right over that of the bank, assignee from the contractor of moneys due, to the amount due the contractor from the owner.—Id.

PROCEEDINGS TO PERFECT.

(Wis.) Where the last labor and material were furnished by a subcontractor in August within 60 days of September 19th, when the subcontractor by its attorney sent a letter to the person who represented the owner and the contractor's bond, which letter, though lacking the usual formality of a notice of lien and containing some immaterial matters, nevertheless stated the amount due the subcontractor for work, labor, and materials furnished, and claimed a lien, such letter was also such a notice as is required by St. 1913, Sec. 3315.—Neil & Co. v. Sedlachek, 175 N. W. 89.

(Wis.) Notice of claim of mechanic's lien required by St. 1913, Sec. 3315, may be served on the owner or his agent in a county other than where the property is located, and need not, if service cannot be made in such county, be filed in the office of the clerk of the circuit court of the county.—Neil & Co. v. Sedlachek, 175 N. W. 89.

MATERIAL MEN NOT RESPONSIBLE EXCEPT TO PURCHASER.

(La.) Materialman, who was not a party to contract between paving contractor and parish, was not responsible to contractor in damages ex contractu upon breach of its contract with parish to deliver material, though contract between contractor and parish provided that contractor should have recourse against materialman for his losses upon materialman's failure to deliver according to its contract with parish.—Police Jury for Parish of St. Landry v. Alexandria Gravel Co., 83 So. 316.

SURETY NOT LIABLE FOR SHOVEL RENT.

(Cal.App.) A surety on a bond of a state highway contractor, made pursuant to the provisions of St. 1897, p. 201, amended by St. 1911, p. 1422, was not liable to one who leased a steam shovel to another, who furnished the shovel to a subcontractor, although it was agreed between the subcontractor and the one who furnished him the shovel and the lessor of the shovel that the rent for the shovel should be paid to the lessor, and an order on the contractor was given by the subcontractor for the payment of the same; the subcontractor agreeing, but failing to pay the same to the lessor, and the one furnishing the shovel not being agent for the lessor under the circumstances.—Norman B. Livermore & Co. v. Guardian Casualty Co., 185 P. 413.

NEWS OF THE SOCIETIES

April 27-29.—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 4-6.—NATIONAL FIRE PROTECTION ASSOCIATION; Chicago. Secretary, 87 Milk street, Boston.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 4-8. — AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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Texas Roadbuilders' Association.

The first meeting was held at Austin, Texas. Six sessions were held, besides an illustrated lecture by the representative of the Lakewood Engineering Co., and a meeting for perfecting the organization.

Reports were presented on work by the division engineers of the State Highway Department, and an address by C. N. Fowler, member of the State Highway Commission, on "Future Federal and State Participation in Highway Construction."

Among others the following papers were presented: "Relation of Federal Bureau of Public Roads to State and Federal Aid Projects," by J. D. Fauntleroy, District Engineer, U. S. Bureau of Public Roads; "Relation of State Highway Department to State and Federal Aid Projects," by C. H. Kendall, Assistant State Highway Engineer of Texas; "State and Federal Aid Projects from Contractor's Viewpoint and Suggestions for Betterments," by G. C. Hawley, of the Texas Bitulithic Co.: "Relation of Counties to State and Federal Aid Projects; Present Conditions as to Co-operation and Suggestions for Betterments," by F. E. Hess, of Dallas; "Misunderstanding Concerning Functions of State Highway Department," "Federal Equipment—the Handling by the State after its Receipt; Organization Methods"; "Desirability of Building More Permanent Types of Roads," by R. V. Glenn, Consulting Engineer of Tarrant County; "Surveys and Plans—Present Methods of Preparation and Recommendations for Betterments," by Julian Montgomery, County Engineer of Rockwall County; "Drainage Problems and Designs of Modern Highway Drainage Structures," by G. G. Wickline, Bridge Engineer of the Texas State Highway Department; "Road Materials—State's Relation to Location and Development of Sources and Transportation," by T. H. Webb, Engineer of Materials and Tests, Texas State Highway Department; "The County Engineer," by Terrell Bartlett, of San Antonio; "Road Materials—Testing and Grading," by R. G. Tyler, Associate Professor of Highway Engineering, University of Texas; "Special Construction Features," by W. O. Washington, of Whiteaker & Washington, San Antonio; "Aggregate and Methods of Preparing Concrete Mixtures," by F. E. Geisecke, Chief Division Engineer, Bureau of Economic Geology and Technology, University of Texas; "Making Concrete for Highway Pavements and Bridges," by L. H. Edwards, Senior Highway Bridge Engineer, U. S. Bureau of Public Roads; "Topeka Pavements," by R. M. Green, Professor of Highway Engineering, Texas Agricultural and Mechanical College; "Bituminous Surface Treatments," by M. C. Wellborn, Division Engineer, Texas State Highway Department; "State Organization for Highway Maintenance," by R. J. Windrow, State Highway Engineer; "County Organization for Highway Maintenance," by Manton Hannah, County Engineer of McLennan County, Texas.

At the organization meeting it was decided to hold meetings semi-annually, one to be at Austin and the other at a place selected by vote of the members. An invitation to hold a meeting at Waco was accepted.

Officers elected: President, R. J. Tyler, Associate Professor of Highway Engineering, University of Texas; vice-president for North Texas, R. V. Glenn, Consulting Engineer of Tarrant County, Ft. Worth; vice-president for South Texas, L. W. Kemp, of The Texas Co., Houston; vice-president for East Texas, N. B. Gregory, Contractor, Texarkana; vice-president for West Texas, E. M. Overshiner, County Judge of Taylor County, Abilene.

Four directors, one engineer, one contractor, one material man and the other a county official, were elected. J. C. Nagle, Dean of Engineering Department, Texas Agricultural and Mechanical College, engineer; R. J. Potts, of Potts & Prentice, Waco, contractor; E. L. Dennis, Jr., of the Texas Trap Rock Co., San Antonio, material man; and Cecil L. Simpson, County Judge of Dallas County, Dallas, county official.

PERSONALS.

Fulton, Clyde, has been appointed city manager of Roswell, N. Mex.

Buck, Ross J., has been appointed city engineer of Muskegon, Mich.

Sperbeck, George, has been appointed assistant city engineer of Alameda, Cal.

Greer, J. W., has been appointed city manager of Tallahassee, Fla.

Firth, Joseph, has been appointed city manager of West Palm Beach, Fla.

Austin, George T., has been appointed city engineer of Effingham, Ill.

Otter, Gus, has been appointed county engineer of Ashland County, Ohio.

Umland, B. F., has been appointed highway engineer of Pennsylvania County.

Clark, LeRoy F., has resigned as city engineer of Batavia, N. Y.

West, W. C., of Buckhannon, W. Va., has been appointed road engineer of Houghton County, Mich.

Calkins, A. S., has been appointed city engineer of Joliet, Ill.

Murray, Joseph A., Jr., has been appointed principal assistant in the city bureau of engineering of Albany, N. Y.

Allen, Judge B. M., of Birmingham, Ala., has been elected president of the Bankhead National Highway Association.

The Blinn Engineering Co., Coshocton, O., has been organized by Ray S. Blinn, for municipal engineering practice.

Wespiser, Joseph, and Vanausdall, A. D., will engage in the contracting business at Oxford, Ohio.

Nevin, James R., has been elected county engineer of Jefferson County, Iowa.

Cooper, W. J., Hilton, F. E., and Mann, Harold, have organized the General Industrial Corporation for engineering and contracting at Kemmerer, Wyo.

Kidd, Herbert L., has been appointed city manager of Kingsport, Tenn.

New Appliances

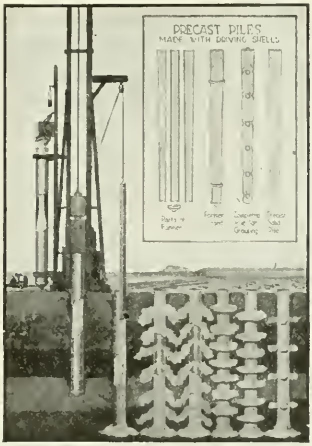
Blumenthal-Gardner Concrete Piles

The Concrete Pile and Foundation Company offers a system of concrete foundation piles with new details of design and construction methods intended to facilitate their installation and increase their bearing power in soft soils.

Important features are the use of a longitudinally split detachable steel driving form that it is claimed can be used and removed more advantageously than the ordinary single-piece shell, and the use of temporary and perforated steel shells permitting the formation of exterior projections made by ramming concrete in the body of the pile until it is forced out through the openings into the surrounding soil. As many as 200 2-inch projections are estimated to be produced on the surface of a 16-inch pile 30 feet long.

Other features are the formation of mushroom extensions at the base and at intermediate positions of the pile above it and the use of a system of interior pipe manifolds, embedded in the concrete of the pile and permitting the application of grout after the pile is driven, to penetrate the exterior soil.

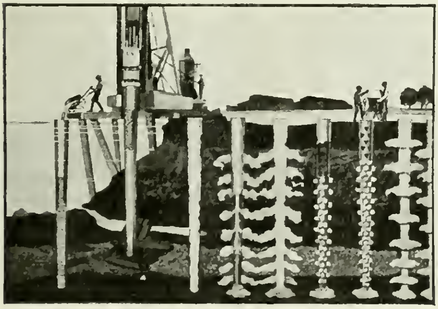
The inventors provide a waterproof lining to be inserted in the field shell and filled with concrete before the pile is driven with the intention of securing protection from running water or from acids. A device is also provided for enlarging a cavity produced at the foot of the pile so that when concreted, projecting arms will be formed there. Advantages are also claimed for a process of filling the shells with wet concrete before driving and thus securing extra density of the concrete.



PERFORMING THREE OPERATIONS AT ONE TIME, FILLING SHELL, DRIVING SHELL, AND WITHDRAWING SHELL.

The same split shells that are used for the cast-in-place piles are equally available for casting piles on the surface of the ground which may be stripped and left to season before driving. Rapidity of operation and superiority of piles is claimed for a method worked out for the installation of these piles whereby 3 successive operations are simultaneously in progress continuously, namely, the filling of one pile shell upon the surface of the ground, the driving of the next pile, and the removal of the shell from the second pile, all operated from the same driving tower.

This type of construction, called the Blumenthal-Gardner system, is recommended by its promoters, the Concrete Pile and Foundation Co., for foundations and continuous retaining walls, for operation under water.



DRIVING CAST-IN-PLACE CONCRETE PILES THROUGH WATER OR WATER SOILS, USING EITHER FILLED SHELL OR FILLING AFTER SHELL IS DRIVEN

The Clark Meter Box.

The cylindrical vitrified meter box with locked sections cover manufacturer by the H. W. Clark Co. are recommended by that company for ten reasons: first, ready access for reading, inspection and repair at all times; second, reading of meter without annoyance to consumer; third, meter may be read at any time regardless whether or not the occupants of premises are at home; fourth, detection of underground and all other leaks in entire service line and fixtures; fifth, prevention of by-passing connections in front of meter; sixth, absolute protection to meter from frost; seventh, protection to meter from fire and damage of all kinds; eighth, protection from tampering with meter by unauthorized persons; ninth, protection to consumer from burglars who often gain admission to the house under guise of meter readers; tenth, protection to the water department from personal injury damage suits arising from persons stepping or falling into unprotected meter boxes.

INDUSTRIAL NOTES

Important Announcement.

The Highway Materials Department of the H. H. Robertson Company has been purchased by the National Steel Fabric Company of Pittsburgh, Pa., and the balance of all unfilled fabric orders will be shipped by the National Steel Fabric Company.

Correspondence relating to past contracts or new business should be addressed to the National Steel Fabric Company, First National Bank Building, Pittsburgh, Pa., of which E. L. Benedict, formerly manager of the H. H. Robertson Co.'s Highway Materials Department, is general sales manager.

National Data Book Service.

Holders of Robertson Data Books are advised that the National Steel Fabric Company takes pleasure in announcing that the service rendered last year to those indirectly and directly interested in highway affairs will be continued as the National Data Book Service.

The National Steel Fabric Company trusts that this service will be of interest to you and assumes that it will have your co-operation in the matter of furnishing accurate information to those interested in permanent highway construction.

The George Cutter Company and the Westinghouse Electric & Manufacturing Company.

The George Cutter Company, of South Bend, Indiana, announces the acquisition by the Westinghouse Electric & Manufacturing Company of a financial interest in their company. The management and the commercial policies will remain unchanged, but advantage will be taken of the Westinghouse engineering and other facilities to expand the Cutter Company's activities and develop its lines to enable it to more effectively serve its customers and the industry. The Westinghouse Company will operate as sole distributors for the Cutter Company's products.

Asphalt Association.

Permanent headquarters have been established at 25 West 43rd Street, New York City.

Pittsburgh Pressure Filters.

Pressure filters manufactured by the Pittsburgh Filter & Engineering Co., are of standard sizes from 6,000 to 150,000 gallons daily capacity and are made vertical and horizontal; with settling compartments for muddy waters; with geared agitator; and with single and double tanks.

The standard horizontal filter, 8 feet in diameter and with capacities of 200,000 gallons a day upwards according to the length are recommended for small water works plants.

Rollin Construction Corporation.

J. J. Collins, W. D. Hammond and Linton Hart, formerly of the Raymond Concrete Pile Company and the Dock Contractor Company, announce the Rollin Construction Corporation, engaging in general construction, with offices at 90 West Street, New York City, and 80 Boylston Street, Boston, Mass.

Advertising Paving Progress.

Windes & Marsh have obtained publicity results which they consider satisfactory in advertising the progress of construction on about 68,000 yd. of concrete street pavement that is being executed under their direction at Winnetka, Ill., by the Marquette Construction Co., contractor. A large signboard is erected in the street in a conspicuous place and is marked in large letters, Winnetka South East Paving. 5½ miles reinforced concrete, Progress. Underneath this caption there are three vertical columns headed, Grading, Drainage, and Concrete Laid, respectively. These columns are divided by ten horizontal lines each representing ten per cent of the work, and as the latter progresses the columns are filled in accordingly from the bottom up showing at any moment what proportion of the work is finished. The effect of this diagram has been to interest the taxpayers and to stimulate the contractor who maintains creditable progress.

Liquid Chlorine.

Liquid chlorine under a pressure of about 100 pounds per square inch is shipped in heavy cylinders containing 100 and 150 pounds and in tank cars with a capacity of 30,000 pounds. When released from the tanks or cylinders the chlorine immediately gassifies.

Liquid chlorine is now used in more than 3,000 installations in the United States for the sterilization of water supplies and disinfection of sewage effluents. For the purification of drinking water an example is cited in western New York State where a town suffering from a few cases of typhoid fever purified the drinking water at an operating cost of only 15 cents per day for the liquid chlorine after the installation of the chlorinator. The chlorinators are provided to suit every system, whether pump suction, pressure main, or open well, for the smallest town or the largest city, and are either manually or automatically controlled.

United Iron Works, Co.

Bulletin 50 illustrated several styles of cast iron lamp posts for city lighting. They are designed for 3, 4, or 5 globes, and one type has an upper extension carrying telegraph or telephone wires.

Rapid Gravel Dredging.

Remarkably good results for submerged excavation under difficulties were attained with a derrick barge owned by the Cadwell Sand & Gravel Company, Windsor, Ontario, which was equipped with a 2-yard clamshell bucket operated by 10 by 12-inch American hoisting engine and dug 100 yards of gravel per hour in 40 feet of water with a 9-mile current. This required an average of more than one bucket full per minute and efficient handling to remove the gravel as fast as dredged.

A Large Powerful Roof Derrick.

Ocean steamers are loaded with heavy freight by a 25-ton American derrick installed on the roof of the Union Pacific Pier Shed at Seattle, Washington. It has a 20 by 20-inch 45-foot mast and a 16 by 16-inch, 60-foot boom, with standard fittings. The nominal capacity is 25 tons and it is operated by an American 7 by 10-inch hoisting engine with excess capacity that has handled without difficulty, a large number of 27 ½-ton locomotive boilers but has never required any expense for repairs.

Solvay Graphite Paint.

This paint manufactured by the Solvay Process Company is especially recommended by them for bridges, corrugated iron buildings, and other metal structures, because, being made of amorphous graphite, refined pitch, and vegetable oils, all of which are absolutely inert and resistent to atmospheric influences, it is a very durable covering for iron and steel. It is a black paint with a covering capacity of 550 square feet per gallon, and requires from 24 to 36 hours for drying. Under normal conditions it will last from 3 to 10 years, depending on conditions and the care with which it is applied.

PROBLEMS CITIES ARE STUDYING WITH EXPERTS.

Plans for a $381,000 municipal HYDRO-ELECTRIC POWER PLANT have been submitted to the water commissioner of Walla Walla, Oregon by E. D. Hussey, Seattle, who proposes to generate about 1,000 kilowatts from a flow of 50 secon-feet at 350 head which, allowing for 10 per cent loss in transmission, should deliver about 1,200 h.p. at the city line.

City Engineer Cowden of Harrisburg and engineers representing the Pennsylvania and Reading railroads and the Harrisburg Railway Company have been considering plans for the elimination of GRADE CROSSINGS in the proposed short line to Steelton. One of the plans involves a 334-foot bridge span, another requires a bridge 650 feet long and another requires a 1,000-foot bridge of several spans.

Elrod, Henry E., has been retained by the City of Galveston to appraise the properties of the Galveston WHARF COMPANY and the Brush ELECTRIC COMPANY, for the purposes of taxation and rate regulation, respectively.

The Henry Exall Elrod Company has plans and specifications ready for a DAM for the City of Cisco, to cost approximately $350,000.

It is also in the market for a twelve-ton municipal GARBAGE INCINERATOR for the City of Cisco, Texas.

The Mangum, Oklahoma, Board of Commissioners have retained Johnson & Benham, consulting engineers, Kansas City, Missouri, as consulting and supervising engineers for an elaborate system of STREET PAVING which is being planned. The first district will comprise only the business district, but later it is expected to extend the work to cover a great portion of the residence district. It is estimated that the work will total $600,000.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, APRIL 24, 1920 No. 15

Refuse Disposal in Savannah

All refuse is collected, unseparated, by wagons and carts and burned in a destructor. This creates steam, which operates the plant and, used by the water works pumping plant, saves it $10,000 to $12,000 a year in coal. The destructor, six years old, received its first repairs last year.

The refuse of Savannah, Ga., is burned in a destructor. This applies to all the refuse—garbage, rubbish and ashes—except iron and other metals, plaster and other non-combustible rubbish which, with a small amount of paper and other combustible matters, are dumped on swampy land east of the destructor.

COLLECTION.

The refuse is collected by means of 37 wagons each drawn by two mules, and 8 carts each drawn by one mule. Mules and wagons and carts are owned by the city, and are kept in a municipal stable not far from the destructor plant. Some of these collect two loads a day and some three loads. Collections are made daily from practically all buildings. The destructor lies at one edge of the city, near the railroads, and is about 1½ miles from the business center and 4 miles from the most distant point of the city.

All the refuse is collected together and no record is possible of the relative amounts of each; but the superintendent of this utility and of the water works, Lewis A. East, estimates that about one-seventh of the total is ashes. As each wagon or cart reaches the plant it is weighed, and an accurate record is thus kept of the amount collected and disposed of. This is an average of about 70 tons a day. During the year 1919 the total was 22,885.25 tons. The monthly totals ranged from 1,644 to 1,896 tons, except during July and August, when watermelon rinds caused an increase to 2,734 and 2,298 tons, respectively.

In general, about 3 minutes is required to weigh

DESTRUCTOR (IN THE FOREGROUND) AND WATER WORKS PUMPING STATION (IN THE BACKGROUND) AT SAVANNAH.

a load, dump it into the destructor pit and leave the grounds; but when several loads arrive at once, the last may be on the grounds 15 or 20 minutes. Wagons and carts are rear-dump. More or less use of fork or shovel is required to get all of the refuse out of them into the pit. One man is kept in the pit all day to work the refuse back from the dumping point and help unload.

The city expects to put into use soon two 3-ton trucks as tractors, using the present wagons and carts as trailers, these to be replaced by regular trailers as they wear out. Collection will be made by these trailers hauled by mules, which will be left in alleys at their intersection with a designated street, from which points they will be collected by the tractor-trucks and hauled, in trains of four or five, to the destructor. There will also be a 1½-ton truck for removing dead horses and for general service.

THE DESTRUCTOR.

The destructor is of the Heenan type, completed by The Destructor Company in 1914. It consists of two 4-cell units, operated by forced draught. (This plant was described by *Municipal Journal* in the issue of February 11, 1915. We are informed that this make of plant is no longer being installed in this country.) The heat is utilized to raise steam and superheat it, a Foster superheater being used. Part of this steam is utilized for operating a Westinghouse direct-current generator, the current being used for lighting the plant and operating the various parts of it. Most of the steam, however, is used by the water works pumping plant, which is only a few feet distant. It cost $33,852 to operate the destructor during the year 1919, and the steam furnished to the water works plant saved $10,000 to $12,000 in coal.

Only one unit of the destructor is operated during Monday, Tuesday and Wednesday, but both are used during the remaining three days, or so much of them as may be necessary to clean out the refuse storage pit by Sunday. (The guaranteed capacity of each unit was 390 tons in six days, while the refuse delivered averages 490 tons and exceeds this part of the time.) When both are operating, they furnish almost all the steam needed for pumping.

During the first half of the week the unit not in use is cleaned out. This cleaning includes removing the ashes from the combustion chamber and the clinker from the grates. The clinker is drawn out by power onto steel dump cars, which, since last May, have been taken to the dumping grounds, two or three hundred feet away, by caterpillar tractors furnished by the Cleveland Tractor Company, of which there are three. Formerly, mules were used for this service, at greater cost. Most of the clinker is dumped, but some has been used as base for street surfaces. The cost of clinker disposal in 1919 was $1,653.

DUMPING GROUND NEAR INCINERATOR.
Large lumps of clinker are shown at the top of the pile.

TRACTOR USED FOR HAULING CLINKER CARS.

No fuel is used in the furnaces other than rubbish, the more combustible of which is used for starting fires after a shut-down. No supplies (other than for repairs) are purchased except oil and occasional replacement of minor tools.

Twenty-three men are employed at the plant, one in the pit, one weighing the loads, and, on each of three shifts, an engineer, craneman, three firemen and two laborers.

Three years ago the grate bars were replaced, and should now be renewed again. Aside from this, the first repairs to the plant were made last year, when the lining of the combustion chamber was renewed, repairs made to the hoppers, and some others, at a total cost of about $5,000.

Reservoir Maintenance in Hartford

High color was found to be due to swamps and to weeds growing along the reservoir shores, and was eliminated. Reservoir gangs were kept busy on the water-shed winter and summer.

In the 1919 report of Caleb Mills Saville, manager and chief engineer of the Hartford Water Department, the following comments upon the water supply of that city are found:

> Some rather high colors are found in the various waters supplying Hartford. Of the present reservoirs, Nos. 1 and 4 are the highest and Nos. 2 and 6 the lowest. These are all old reservoirs and their condition is so stabilized that little or no changes from year to year may be expected under ordinary conditions. Such matters are attended to by cutting of weeds on the shores when the water is low, by planting coniferous trees along the reservoir shores to act as a screen to prevent leaves of other trees from getting into the water, and by some swamp drainage. The average color in the Nepaug reservoir is considerably lower than for the past two years, as was anticipated. The reduction of color here has followed to a very remarkable extent the predictions made by F.

P. Stearns, consulting engineer, two years ago, and the results are such as to warrant belief that the expectation of a future color of this water comparable with the best that Hartford now has will not be disappointed. While the natural influences are at work to bring about this result, this time can be hastened and possibly even better results obtained by swamp drainage in the area tributary to Phelps brook, which the board plans to undertake. The swamp area here is comparatively small and mostly on land now owned by the board. From this area, however, comes most of the color produced outside the reservoir proper. Other causes producing color in the reservoir will be gradually eliminated by natural agencies. Those in the water shed, however, will be perpetuated unless the action above referred to is taken. The results obtained elsewhere make it certain that the improvements stated above are of great value and it is intended to undertake them from year to year with the forces of the board.

The interesting feature of this is the recognition that, although there is only a small amount of swamp area on the water-shed, most of the color comes from this; and that formation of color in the reservoir itself may be largely prevented by cutting weeds on the shore when the water is low and by planting coniferous trees along the shores of the reservoir.

During the same year two small maintenance gangs, each averaging about three men with a foreman in charge, were employed continuously at the Nepaug reservoir, one at each of the two dams. Each of these kept in repair a road crossing the reservoir site, cleaning out the gutters and catchbasins and building fences as required. They also kept the brush, weeds and grass cut along the shore line of the reservoir and for a distance of 25 feet back from the water.

They also cut out diseased chestnut trees and carried on reforestation work by planting 35,000 small pine trees. One gang made an inspection of all of the brooks in the upper portion of the water-shed to ascertain the source of high color in certain of them. This gang also cut 33 tons of hay, 15 telephone poles, 217 ties, 7,000 feet of lumber and 62 cords of wood. The other gang planted four acres of land to buckwheat and harvested the crop of 35 bushels in the fall; cut 75 cords of wood and 79 railroad ties. The two gangs combined cleaned the filter plant in September, removing, washing, regrading and replacing all the sand and gravel.

Kenova Bridge End Span Erection

Two single-track, 298-foot spans, 100 feet above water level, replaced by double-track spans on the same substructure without interrupting traffic. Old stringers supported on falsework that carried the traffic and the new span erected on its suspended floorbeams. Tops of old piers rebuilt, new span lowered to permanent support on them, old trusses and subsequently old floor and falsework removed by travelers supported on new span.

The Norfolk & Western Railway Company's single-track bridge across the Ohio River at Kenova, West Virginia, included a five span structure 1,800 feet long and 100 feet above water level which was replaced by a double-track structure of the same grade and alignment without interrupting railway traffic or river navigation. The two duplicate 298-foot end spans were replaced by a falsework method containing some unusual features that eliminated most of the danger to both old and new structures that might be occasioned by floods washing out the falsework, and which is described in the present article. A reconstruction of the adjacent intermediate spans was described in Public Works, March 27, page 237, and the unusual method adopted for the rebuilding of the 518-foot centre span will be illustrated in a future article in Public Works. All of these operations, although applied to a railway structure are equally suitable for the renewal of a highway bridge and as the same or similar problems involving traffic and navigation, protection from floods and utilization of substructure are likely to occur in the latter type of structures, the methods and operations employed for the railroad bridge are of interest and value for the solution of reconstruction problems for state, municipal, or county bridges that are often in charge of officials to whom the services of the highly specialized staff that handled this railroad bridge are not easily available

At the time of reconstruction, the Kenova Bridge was subjected to a traffic consisting principally of coal trains of 50 to 75 cars each, passing about every 20 minutes, day and night. The height of the bridge piers and the possibility of a flood in the river that might endanger the falsework, together with the fact that the existing piers were not long enough to receive the wide new structure, added considerably to the difficulties and expense of the work. Although it was forbidden to use falsework in the river channel, its use was permissible on both sides of the river where the ground was partly or wholly above water level according to the stage of the river.

After the replacement of the 2,148-foot single-track plate girder viaduct approach at one end of

FALSEWORK BENTS PARTLY ERECTED AND NEW FLOOR-BEAMS SUSPENDED UNDER OLD 298-FOOT SPAN.

the bridge by a double-track structure the tops of the tall masonry piers for the main spans were cut down and long plate girders transverse to the bridge axis were installed on them to support the wider new spans, an operation which was executed by ingenious and skillful operations that did not interfere with traffic. After the pier girders were in place, three-story framed timber falsework bents on pile foundations were installed under the end spans and the support of the old track stringers was transferred to them, relieving the old spans of live loads. The old spans were then competent to carry the new spans during erection, thus avoiding any danger that might be threatened to either old or new spans by the destruction of the falsework.

FALSEWORK.

Nine falsework bents about 30 feet apart, were erected under the panel point of the old trusses and were braced longitudinally with two double lines of 10 x 12-inch timbers and in alternate panels with 4 x 8-inch X-braces. Clearance was left between the upper caps and the bottoms of the old floorbeams and on each side of the bridge axis there were placed on the caps a double line of 15-inch 42-pound I-beams to support the old bridge floor. The new floorbeams, extended by a detachable cantilever bracket at each end to carry the temporary service tracks, were inserted between the top of the falsework and the bottom chords and floorbeams of the old span, and each was temporarily blocked up on the falsework. Pony bents were then erected each side of the new floorbeams on the longitudinal 15-inch I-beams and the old stringers wedged to bearing on them and detached from the old floorbeams, thus transferring the support of the traffic to the falsework.

The trusses thus being relieved of live loads and impact were competent to carry an equivalent additional dead load and the new floorbeams were accordingly suspended from the old floorbeams by a pair of 3-inch vertical screw rods at each end, carefully adjusted to give the computed number to the trusses. Pairs of 15-inch longitudinal I-beams were supported at panel points over the two horizontal middle panels of top chord of the old trusses, on them was laid a track, and a two-boom platform traveler was installed there with which pony bents of falsework, carrying in the plane of each truss a pair of 20-inch longitudinal I-beams, were built and supported at the panel points of the inclined top chords from the center to the end of the old span, thus providing for the movement of the overhead erection traveler from end to end of the span.

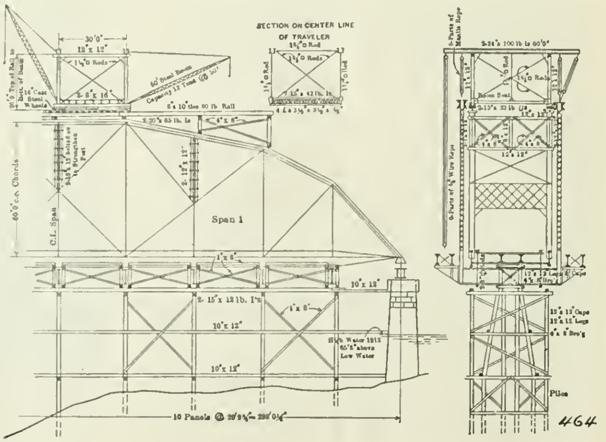
ERECTION TRAVELER

The platform traveler had a 30 x 34-foot frame, supported on four wheels with a tower about 27 feet high over all with four vertical posts, between which were the two front and rear 50-foot steel derrick booms of 12 tons capacity. The tops of the vertical posts were connected by pairs of 24-inch 100-pound transverse I-beams 60 feet long that cantilevered 13 feet beyond the centers of the old trusses providing abundant overhang for tackles concentric with the service tracks and the new trusses by which the material for the new span was unloaded and erected. This traveler was erected by a 6-ton jinnywink and was equipped with a four-drum, eight-spool, 100-h. p. electric hoisting engine.

The traveler erected stringers on the cantilever projections at both ends of the new floorbeams on which a service track was installed enabling the material for the new trusses to be delivered to the traveler without interfering with traffic on the main line through the old spans. The bottom chords were unloaded from the service track by wire rope tackles, and fleeted to position by manila rope tackles after which the web members of the trusses were delivered and erected, the new floorbeams being wedged to bearing on the outer posts of the falsework to avoid imposing too much additional load on the old span trusses.

The 54-ton end posts of the span were erected by the traveler lifting one end and by a derrick car on the main line.

After the new top chords were erected, the traveler removed the falsework over the inclined panels of top chords, simultaneously erecting the



FALSEWORK AND TRAVELER FOR ERECTION OF NEW DOUBLE-TRACK TRUSSES OUTSIDE OF OLD SINGLE-TRACK TRUSSES.

new portals and part of the top lateral and sway brace system, and retreating to a position over the center panels of the old truss where the track was not removed.

Jacking girders were then attached to the bottom of each of the end posts and two 500-ton hydraulic jacks were operated at each post to lift the new span 5 inches, permitting the rods that suspended it from the old floorbeams to be disconnected after which the jacks were slacked off, lowering the span to permanent bearing on the pier girders.

A traveler track was laid on the horizontal top chords of the new span, the traveler was jacked up and extensions placed under it to enable it to run on the broader gage new track. The traveler than assembled on the new track the 43 x 30-foot platform of a new 423,000-pound traveler and erected on it a steel derrick with a 65-foot boom of 12 tons capacity that completed the erection of the new traveler and was subsequently removed by the old traveler.

The new traveler, illustrated on page 238 of the previous article, was equipped with two 75-foot steel booms with a maximum capacity of 60 tons each, and the electric hoisting engine was transferred from the old traveler and replaced there by a two-drum, four-spool steam hoisting engine.

REMOVAL OF FALSEWORK AND OLD SPAN.

The pony bents that supported the traffic during the erection of the new span having been removed, the 15-inch longitudinal I-beams that carried them were also removed and placed on top of the new floorbeams to support the old span which was wedged to bearing on them. The old trusses and bracing and the old falsework were removed by both travelers moving on the top chord track of the new span. The old floor system was not removed at the same time but was allowed to remain blocked up on the I-beams until the completion of all the new spans. The cantilever extensions of the floor beams were also left temporarily in position to carry the service track that was used for the erection of the center and intermediate spans. The small traveler also remained available for use until after the completion of the channel span which together with the intermediate spans were erected by the large traveler above mentioned.

The bridge was designed, fabricated and erected by the American Bridge Company, C. W. Bryan, chief engineer, C. G. E. Larsson, assistant chief engineer, who devised the general construction method, W. G. Grove and Henry Taylor, assistant engineers. The diagrams illustrating this article are reprinted from a paper by W. C. Grove and Henry Taylor, published in the Transactions of the American Society of Civil Engineers, Volume 79, page 411.

An important canal project is for the connection of Lake Erie and the Ohio River by 101 miles of a canal 12 feet deep, 140 feet wide at the bottom and 188 feet wide at water level, with a total lockage of 559 feet, that will have, if built as a single-lock structure, a capacity of 38,000,000 tons and will effect a net saving of 50c per ton of material carried through it.

Bridge Numbering in Kansas

The county engineer of Republic county, Kansas, E. A. D. Parker, sends us a description of the method of numbering highway bridges which is employed in his county, in order that it may be compared with that of Mercer county, N. J., described in our issue of February 14.

The method employed in Kansas, while it would probably serve equally well for many of the other states in that section of the country, could not conveniently be applied in the eastern states, for the reason that in the central states practically all of the roads are laid out on section lines, running due north and south or east and west, while in the eastern states the location of roads is determined by the topography and directness of travel to a very large degree, and probably in no cases do they follow artificial lines such as the boundaries between townships, etc.

Mr. Parker sends a blueprint of Republic county, on which are shown all of the section lines, streams, railroads, and highways, the section numbers also being given. On the back of each voucher relating to a bridge or culvert is printed the following notice:

The Numbering of Bridges and Culverts.

Spans of 10 feet or less are Culverts; spans over 10 feet are Bridges. C before the figures indicates a Culvert, B a Bridge. These letters are always to be placed before the figures. The first figure is the Township number, the next the Range number, the third, or third and fourth figures are the Section number, the last figure is the number of the bridge or culvert on the section line, counting from the northeast or southeast corner of the section, and the letter following the figures shows whether it is on the east or south line of the section. This shows exactly where the Bridge or Culvert is in the county. On the north or west line of the COUNTY the letters N and W would be used, and the count be made from the northeast and northwest corners of the section.

As an illustration, B 23361 S indicates a bridge in Township 2, Range 3, on the south line of Section 36, being the first bridge on that line from the southeast corner of the section.

Wayne County Secures Its Own Gravel

Public Works has for the past two or three years advocated the securing of gravel pits, quarries, etc., by county and state highway departments, as well as by city paving departments, both in order to have the material under better control as to both quantity and quality, and also to develop throughout various counties and states as many local supplies as possible to cut down the delay, cost and other inconveniences caused by transportation.

Wayne county, Michigan, last year leased a gravel bed in Northville, and developed its own supply for concrete roads in the vicinity. The lease was secured on a basis of 15c. per cubic yard of material in the bank, payment to be made on the basis of the number of cubic yards of concrete pavement laid. A washing plant was erected having a capacity of 200 cubic yards a day, the approach to the gravel bed was graded and an industrial railway led to the chutes of the washing plant bins. The layout of the deposit was such that it was cheaper to arrange a yard at the bed than it would have been to unload from railway cars; in addition to which, the haul was less by about a half-mile than it would have been from the nearest railroad siding.

A small stream flowing from local springs furnished an abundant supply of water, which was pumped 1,000 feet through two lines of 3-inch pipe by electric motor. A single line of 4-inch pipe would have sufficed, but 3-inch pipe was used because it was in stock. The daily cost of operation totals $76—comprising $32 for 4 teams, $10 for 2 scrapers, $6.50 for a foreman, $6 for an operator, $10 for two car loaders, $1.50 for motor rental and $10 for electric current.

Last year the average daily output was 200 cubic yards, giving a cost of 53c. per cubic yard loaded in industrial cars ready to haul. In the above cost, the largest item was that of 4 teams, which were used to load the hopper which feeds the belt. This could have been eliminated by installing a drag-line bucket and hoisting engine, but because of the short run which this plant would have, it was not considered advisable to increase the investment to that extent.

Commercial gravel cost $1.50 per ton or $2.25 per cubic yard unloaded into industrial cars, if brought in by rail, from which it appears that the plant saved the county about $1.72 per cubic yard of the material produced. It is expected that there will ultimately be used approximately 10,000 cubic yards of material from this bed, which will show a gross saving of $17,200. The plant cost about $7,200 to erect.

This year it is expected to operate the plant a few months to supply gravel for maintaining 24 miles of gravel road, the maintenance of which requires from 3,000 to 4,000 cubic yards of gravel per year. Coarse sand taken from the plant will also be used for maintaining crack and joints in a large mileage of concrete roads.

Viaduct to Reach Pumping Station

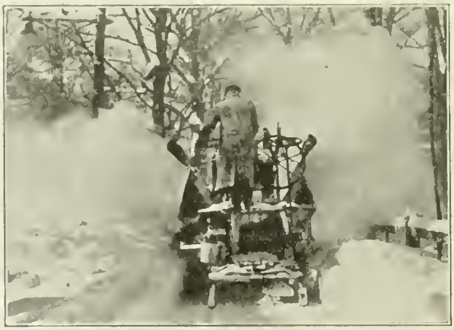
The pumping station and filtration plant of the Evansville, Ind., municipal water works are located on a small island, which is connected with the main land by a road which, although it has been raised from time to time, is covered during flood stages of the river, cutting off the water works plant from the main land.

The embankment which forms the road is also utilized for covering the two 30-inch force mains leading from the pumping station to the city. The successive raising of the road has resulted in burying these mains under about 16 feet of earth. and it is not thought advisable to bury them any deeper by raising the road any higher. Moreover, it is considered certain that, should one of the force mains break, the other would be damaged by the washing out of the embankment before the pumps could be shut down and the valves closed between the break and the city distribution system.

It is therefore the intention of the city, we are informed by the general superintendent of the water works, Charles Streithof, to build a viaduct which will furnish a means of access to the island which will be above the highest water and will also carry a 42-inch force main, which can not be affected by a break in the other two. This viaduct will accommodate motor trucks to be used in hauling coal and chemicals to the plant, and will render unnecessary the motor boats which are now used to carry the employes to and from the plant during high water. This viaduct will be about 2,200 feet long.

Rotary Snowplow for Cleaning Sidewalks

The heavy snowfall of the winter of 1919-20 has called into service in Canada a new type of power-operated rotary snowplow that eats its way through the drifts by producing a miniature blizzard. Four-bladed cutters driven at a speed of 500 revolutions per minute whirl the snow up through the deflecting hoods. The operator can adjust these hoods so as to throw the snow a short distance from the machine, as is desirable in city streets, or 30 to 40 feet from the cut, as on suburban roads.



ROTARY SNOW PLOW, DRIVEN BY GASOLINE ENGINE AND DRAWN BY HORSES.

SHOWING WIDE SPREAD OF SNOW BY ROTARY PLOW.

Four or six horses are used, but the snowplow can also be attached to a tractor or truck. The draft is not heavy. The forward sled will go through a 3-foot drift without trouble, and the rear sled travels in the broken path that has been cleared The height of the cutters can be adjusted so as to leave a bed of snow several inches deep for sleigh traffic. One big advantage in the use of the machine is that the snow is evenly distributed, and thus big banks are not formed, as is the case where the walks or roadways are cleared with shovels.

Kalispell Water Works

This municipal plant uses electrically operated pumps, with a steam turbine as an auxiliary. By installing the latter, a saving of $15,000 in insurance premiums was made to the citizens. The finances of the department are shown by the latest annual statement to be in excellent condition.

The city of Kalispell, Montana, has been operating its water works as a municipally owned utility for six years, and apparently has developed an excellent system. In September, 1913, the voters decided by a ratio of more than three to one to purchase the water system which had previously been operated by the Northern Idaho and Montana Power Company, issuing bonds to the amount of $175,000 to be used for this purpose and for improving the plant. Of this amount, $142,500 was paid for the plant and $2,827 for expenses, leaving $29,673 for improvements. Since that time up to December 31, 1919, the department has used this amount for improvements and also $36,144 derived from the operating accounts of the department.

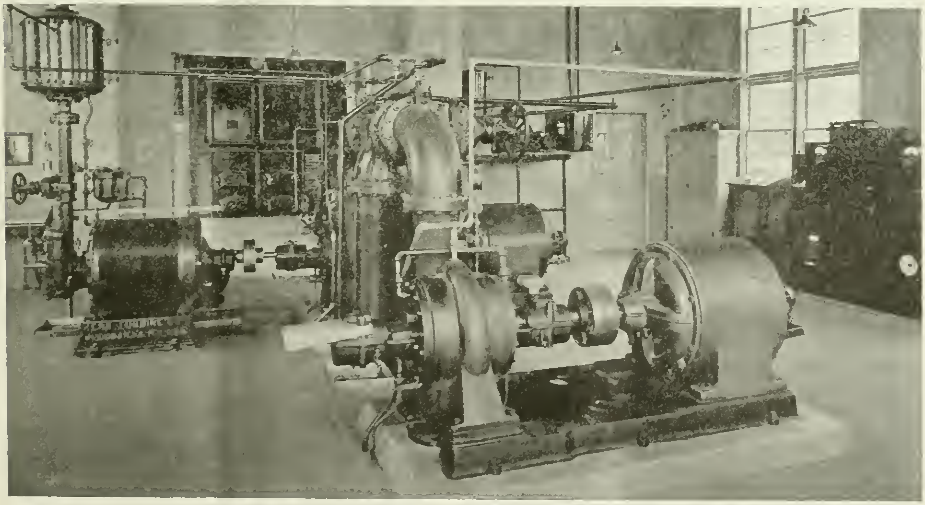
The improvements include a new pumping plant and the land and buildings for installing it, the plant consisting of electrically operated centrifugal pumps, in duplicate, together with a new reservoir and pipe line, and $4,265 expended in building retaining walls, grading and otherwise improving the grounds around the new station.

The new electric pumping plant was completed and went into operation during May, 1916. When constructing the new plant, Mayor Pauline obtained from the insurance companies a reduction of about 33 per cent in the insurance rates charged in that city (equivalent to $15,000 annual saving in premiums), the understanding being that the city would provide a steam auxiliary pumping equipment which would be equal to one of the electric units. To comply with this the city also installed a steam plant consisting of a 225 horse-power Geary water tube boiler and a Kerr Turbine Company steam turbine connected by flexible coupling to the extended shaft of one of the centrifugal pumps. (The illustration herewith shows the electric pumps and the steam turbine so connected to one of them.) The electric pumping equipment cost $6,802, and the steam pumping equipment $8,276.

The electrical equipment is used for all pumping, and the electric service has been so practically uninterrupted that no use has yet been made of the steam plant for pumping water. As the cost of the steam pumping equipment, however, was only a little over half of the annual saving in insurance rates secured by installing it, while the cost of maintaining the pumping equipment and building was only $534 in 1919 and $566 in 1918, the investment in the steam auxiliary was decidedly a paying one.

FINANCES.

The department superintendent, W. H. Lawrence, in his annual report for 1919, gives the cost of the plant at the close of the year as $201,986. The assets of the department include, in addition to this,



KALISPELL PUMPING PLANT.
Steam turbine is shown connected to the shaft of the further centrifugal.

an investment in Liberty Bonds and certificates of deposit of $82,829, and cash and accounts receivable of $30,422. Deducting liabilities, there remains a surplus of $42,299, plus $289 worth of miscellaneous supplies.

The department derives no revenue from the city for hydrant rental or other public uses. Duing the first thirteen months of operation the revenue was $47,188, which was reduced to $32,736 in 1916, and has been gradually increasing to $36,304 in 1919. The net earnings, after deducting depreciation and other fixed charges, were $14,035 the first thirteen months, gradually falling to $2,834 in 1917, and again increasing to $8,282 in 1919. From the investment of its surplus the department received last year interest to the amount of about $4,500.

THE SUPPLY.

The source of supply is a large spring located one mile north of the city and about 600 feet from Stillwater river. Following an investigation made by the State Department of Health in 1917, the secretary of the department reported that "A physical inspection of the spring and its surroundings shows that there are apparently no constant sources of contamination in the immediate vicinity of the spring that could affect the water. The spring itself is properly protected by a concrete structure which is adequate to protect the spring from pollution by surface drainage and infiltration. The water is pumped from the spring to a reservoir located on an elevation ¾ of a mile north of the city. This is a concrete structure with a capacity of 1,800,000 gallons. The surroundings of the storage reservoir are satisfactory from the sanitary aspect. There are no sources of contamination anywhere near the reservoir. The reservoir is protected by a high wire fence. The reservoir is periodically cleaned and flushed. Water is distributed fom the reservoir to the city mains by gravity."

Examinations of the water were made at that time and at intervals since then. An examination by the State Board on three separate occasions during 1919 gave negative results for B-coli in every case, and bacterial counts at 37 degrees C., 24 hours, varying from two to a maximum of twelve. Like all spring waters in that section of the country, this contains considerable mineral matter, the total solids being 226, and the total hardness 138 parts per million. Of the minerals, 180 parts were found as bicarbonate radicle, 48 as chlorine, 42 as calcium, and much smaller quantities of magnesium, silica, sodium and potassium.

A HOUSEHOLD WATER SOFTENER.

Commenting upon the mineral content, the Health Board said: "From the standpoint of mineral content, the Kalispell city water supply is an excellent one for all domestic purposes when compared with the average surface water supplies of Montana. A good household water softener for waters of sufficient hardness to be noticeable is trisodium phosphate. One teaspoon of trisodium phosphate added to five gallons of the Kalispell city water would soften the same satisfactorily for laundry and dish-washing purposes. This chemical would also be satisfactory to soften bath water if an excess is not used. The solid trisodium phosphate should not come in contact with linen goods in the laundry. If trisodium phosphate is dissolved in the water before the clothes are added, there will be no injury to the linen, providing an excess is not used. For dish washing it will be satisfactory to add the solid chemical direct to the dish water. Water softened with trisodium phosphate should not be used for drinking."

PUMPING.

The total amount of water pumped during 1919 was 461,136,800 gallons. This gives an average daily pumpage of 1,264,000, the maximum amount for any one day being 2,433,000 and the minimum amount for one day being 609,000—about 200 per cent and 50 per cent, respectively, of the daily average. This gives an average of 210 gallons per day to each inhabitant. About 22 per cent of the total amount pumped passed through meters.

The amount of gallons pumped per k.w.h. last year varied from a maximum of 1,137 in December to a minimum of 984 in June, averaging 1,087 for the year. This is slightly less than the average for 1917, which was 1,115 gallons per k.w.h., but is much better than in 1915, before the new plant was put into operation, when the average was 629 gallons per k.w.h., the maximum for any one month being 661.

The cost of power last year was $4,156. The expenses of operating the electric power plant during 1919 comprised $3,601 for operating labor, $4,156 for electric current and $502 for supplies and other expenses; giving a total of $8,259 for operation. Nothing was spent during the year for maintenance of equipment or buildings. For the steam power plant, nothing was spent for operating labor, $524 was spent for miscellaneous labor and $10 for supplies, a total of $534.

Although nothing is charged for maintenance of the buildings or equipment, quite extensive improvements were made during the year to the grounds adjacent to the station. The ground was graded for lawn and shrubbery, improving the road to the station, etc. Mr. Lawrence says: "Our aim has been to make the surroundings attractive and kept in as sanitary condition as possible."

DISTRIBUTION SYSTEM.

The distribution system consists of about 20.54 miles of water mains, with 165 gate valves and 226 fire hydrants. The pipe in the distribution system is some of it cast iron, some wood, some kalamein and some spiral riveted. All of the four-inch spiral riveted which had been laid has been removed, and of the 4,569 feet of six-inch, 2,408 feet have been removed. There are 472 feet of six-inch cast iron, 1,830 feet of 8-inch, 2,904 of 12-inch, and 142 feet of 18-inch. No cast iron pipe once laid has been removed. There are in service 36,005 feet of 6-inch wood pipe and 945 feet of 8-inch, 3,444 feet of 13-inch, 5,369 feet of 16-inch and 4,350 feet of 18-inch wood pipe. The only wood pipe which has been removed since being laid was 3,050 feet of 16-inch and 366 feet of 6-inch. Of kalamein pipe, there are in service 2,264 feet of 4-inch, 44,229 feet of 6-inch, 1,823 feet of 10-inch and 2,509 feet of 12-inch; 11,661 feet of different sizes having been removed.

During 1919 the street gang repaired 113 leaks, of which 76 were in wood pipe, 31 in kalamein and 6 in spiral riveted. "In most cases the leaks on wood pipe were found on the collars, caused, we believe, by the contraction and expansion of the pipe line."

The costs for the distribution system are divided under the heads of operating labor, $756; maintenance, $743 for mains, $139 for valves, $640 for hydrants. The total costs of the department for the year are given as $8,793 for pumping, $2,507 for distribution, $4,187 for commercial, $489 general, and $228 undistributed; a total of $16,203.

Competing Water Works in Livingston

Unfortunate conditions seemed to make it necessary for this Montana city to build a municipal plant in competition with a private one, and the latter has been practically driven out of business.

Livingston, Montana, the population of which is about 8,000, has for about a year been served with two water works plants, one private and the other owned by the city. While this is a practice which is not generally to be commended, it would seem that the city was justified in building a competing plant in this particular case.

The water company's source of supply was the Yellowstone river, which at times is subject to pollution and during the spring months is very turbid. The State Board of Health made sanitary surveys of the river and recommended filtration and chlorination. The company, however, declined to follow out these suggestions. Because of dissatisfaction with the quality and pressure of the water, the city had endeavored to purchase the property from the company in 1911, at which time it contended that the franchise it had granted to the company expired; but the company declined to confer with the city's representatives or to make any effort to reach an agreement. Under these conditions, the city considered that its only alternative was to install its own plant. Some years later, acting under the advice of its engineers, and rather than enter into a competitive business, the city officials renewed their efforts to purchase the plant, even offering considerably more for it than an entirely new plant could be built for. The engineers had estimated the cost of reproducing the property at $165,662; also estimating that a plant new and modern in every respect could be built for $225,000.

Following these repeated failures to obtain the plant by purchase, the city voted $260,000 bonds for a complete new plant, including a modern filtration system and an intake located above the outlet of all surface drainage from the city. Injunction suits against the bond election, against the selling of the bonds, against letting contracts and other steps were successively brought by the company, delaying the furtherance of the project, but eventually the city's plant was constructed and has now been in operation for about a year.

The municipal plant contains 14½ miles of mains as compared to 10½ of the private plant; the fire hydrants number 138 as against 96 in the private plant; the storage reservoir has a capacity of 1,000-000 gallons as compared to 415,000; the average domestic pressure is 70 pounds as compared to 35 to 45; and the water is filtered and is considered to be both safe and attractive instead of being of doubtful quality and high turbidity.

During the year of operation the municipal plant has connected 1,180 services to its mains, while the private plant's connections have fallen from 1,330 to 300. It is estimated that the gross income for the coming year will be approximately $35,000. In addition to having safe and attractive water, the citizens have enjoyed a large reduction in their fire insurance rates due to the better protection offered by the municipal plant. The later negotiations and construction have been under the charge of Burns and McDonnell, as consulting engineers, J. A. Cortese, superintendent, and a water committee consisting of J. W. Fryer, A. J. Huffer and the chairman, H. S. Masters.

Safe Blasting

The Aberthaw Construction Co., Boston, in putting up several one-story houses at Lockport, New York, found it necessary to excavate 4,000 or 5,000 yards of rock and installed a motor driven compressor to supply air through 6 or 8 drills with which very satisfactory results were obtained, averaging 16 feet per hour per drill.

The holes were fired in small groups some of which were very close to the railroad track and two wooden office buildings of light construction and having numerous windows. In order to prevent damage from flying stones, each group of holes after being charged with explosives was covered by a bundle of small logs lashed together with rope. When the shot was fired the rock and earth rose several feet in a solid mass covered by the bundle of logs which, although partly disconnected by breaking some of the lashing, still held together close enough to prevent dispersion and maintain an effective shield that prevented stone and fragments from flying upwards or at a large angle in any direction and thus confined the effects of the blast strictly to its locality and prevented any damage to adjacent structures.

The broken rock settled back on the surface of the ground in a solid pile still covered by the logs so that the latter need only to be straightened and bound together for the next blast while the spoil remained in a compact heap ready for easy removal. The cost of the protection was so small as to be negligible both for materials and time and labor and it was so efficient that not even the glass in the close by building was broken but remained in exactly the same condition as before the shot, as is shown by the photographs taken before and after, by Supt. H. V. Sheehan in charge of the work.

Highway Appropriations in Vermont

In connection with the highway data recently furnished us, George W. Plumb, district highway commissioner, informs us that in Vermont the state appropriates for each town $1,000 or any part thereof not less than $100, provided a similar sum is appropriated by the town in question, the total to be used for the permanent improvement of selected highways. In addition to these, there is always available an appropriation known as the 5 per cent fund. The state levies a highway tax of 5 per cent on the "Grand List" of each town and then reapportions it pro rata upon the town road mileage. This also is used on selected highways. The state also donates a few hundred dollars to each town to be expended in the improvement of unselected highways or town roads.

The state contributes two dollars to the town's one, up to $1,500, to be used for resurfacing. The state patrols the main lines of travel at a cost to the towns of about 25 per cent.

Highway Instruction at Drexel Institute, Philadelphia

Drexel Institute, Philadelphia, through its evenning school has arranged a course in highway engineering, and the director has requested us to give publicity to the fact that the institute has secured the services, for the purpose of this course, of Charles F. Puff, assistant chief engineer of the Bureau of Highways of Philadelphia, Otto T. Mayer, assistant engineer of the Bureau of Highways, and Julius Adler, consultant to the Atlantic Refining Company. There will be field work correlated with the class-room work. The course will be given on two evenings a week and Saturday afternoon.

Highway Notes

An attempt is being made to restrain the state highway engineer of Louisiana from letting the contract for the Hammond-New Orleans highway. The reason for this action is that the $700,000 provided for this road and the Chef Menteur road were to be spent so that the Chef Menteur road should be completed or at least amply provided for before the contract for the Hammond-New Orleans highway should be let. Duncan Buie, state highway engineer, was about to let the contract for part of this road to T. G. Womack for $59.541.08, and contended that the $450,000 set aside for the Chef road was amply sufficient.

Well founded objections have been raised to the proposal making five years' previous residence in the state mandatory for eligibility for New Jersey state engineer of highways.

The Board of Freeholders of Elizabeth, N. J., has passed a resolution requiring county municipalities to secure and pay for all rights-of-way before the county will order any roadway work improvements.

Kentucky is planning for a system of highways 3,500 miles long to be constructed and maintained by state funds supplemented by Federal aid. During the next two years the state will have approximately $10,000,000 to expend on highways. Elimination of bad grades and dangerous crossings and the adaptation of surfacing materials to traffic demands is contemplated.

Syracuse plans to lay 6½ miles of new and resurfaced pavements this year.

A bill has been presented to the Kentucky Senate for a tax of 50c. per gallon on whiskey as it is released from bonded warehouses, which it is expected will raise $20,000,000 that will be appropriated for road building.

The state of West Virginia has about $20,000,000 available for road building in 1920, three counties, namely, Kanawha, Fayette and Monongalia counties, having funds of more than $1,000,000 each available.

A $3,000,000 Sea Wall for Corpus Christi, Texas

The city of Corpus Christi is located chiefly on a 42-foot bluff overlooking the harbor, while the business district and part of the residential section is built on a beach at the foot of the bluff, and only about 4 feet above sea level. Last September a tropical hurricane struck the city causing the loss of hundreds of lives and millions of dollars worth of property, and resulted in the change of the plan for a low sea wall, to a much heavier and higher wall located 600 feet beyond the present shore line. Plans and specifications have been prepared and adopted for a wall 16,000 feet long, of which construction on the first 3,000 feet will be commenced about April 15. The wall will be of concrete with a curved face and a height of 12 feet above city datum or 2 feet above the highest water on record. It will have a pile foundation and a sheet pile protection in front, and will be rip-rapped at the toe and the bay filled in to form a bathing beach in front of the wall.

In the rear of the wall the backfill will be graded on a 1 per cent. slope for a distance of 200 feet to a height of 14 feet above the city datum. The first 50 feet will be paved and retained by a small bulkhead. From the crest the fill will slope downwards 400 feet on a 2½ per cent. to the level of Water street on the present shore line. All of the water collecting on the inner edge of the fill will be drained into an intercepting storm sewer and pumped into the bay.

As soon as the first section of the wall is completed, transverse temporary bulkheads will be constructed at the ends and earth dikes will be continued across the beach to the foot of the bluff to protect the most exposed part of the city. Streets will pass through the dikes but can be closed in emergency with sand bags kept in reserve for that purpose. Robert J. Cummins, Houston, consulting engineer.

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False Pride

All have heard, probably, of the two small boys, one of whom in a boasting tone announced that his father had just had a new roof put on his house, which was met by the proud announcement of the other that his father had just had a mortgage put on his. Some people can boast about almost anything, but we think it remains for the city of Chicago to boast about the enormous quantities of water which it wastes. We have just received a pamphlet bearing the title "Boost Chicago," followed by the announcement on the front cover, "We pump more pure water per capita than any city on earth and at a lower cost." Within the cover the pamphlet states that Chicago now has seven cribs with 64 miles of lake and land tunnels in use, representing a total expenditure of $22,000,000; that it has ten major pumping stations representing $13,000,000, which are capable of pumping 900,000,000 gallons a day; that New York City, with over double the population, pumps only 650,000,000 gallons a day, while Chicago pumps 880,000,000, giving an average per capita consumption of 240 gallons a day, with a peak load running over 300 gallons.

A few other statements tending to increase the disgrace about which the city boast are given in striking figures. For instance, "The water pumped in Chicago in one year would cover the entire area of the city to a depth of over seven feet." "One day's pumpage placed in ordinary kitchen pails put side by side would reach around the earth at the equator almost twice." To prove that Chicago can have as much water as it want to pump and pay for, figures are cited to show that, at the present rate of pumping, it would require 5,900 years to pump out the quantity of water in the lake at one time, and that, if the water in Lake Michigan were placed in 40-gallon barrels, set side by side, they would make a belt around the middle of the earth 235 miles wide.

The pamphlet referred to is attractively gotten up and is confined exclusively to amplifications on the large volume of water consumed by Chicago. The comparison to the small boy's boast of the mortgage is by no means a fanciful one, for it has been demonstrated that half of the water pumped is wasted without doing a particle of good to any citizen of Chicago (unless the coal dealers and pump manufacturers), that if the consumption were kept down where it should be, fully $5,000,000 could have been saved on pumping stations and considerably more on tunnels and cribs and probably an equal amount on mains. This $15,000,000 was raised by selling bonds—that is, by putting a mortgage on city property—and the taxpayers are paying interest on this money as well as the cost of pumping half a billion gallons a day without receiving any benefit therefrom. That Mayor Thompson, whose name is signed to the pamphlet, or any other citizens of the city should find it a matter for boasting that Chicago is asking its taxpayers to throw away more money on pumping unnecessary water than any other city in the country strikes us as decidedly humorous—for everyone except Chicago's taxpayers.

The Value of Precedent

With an unlimited command of time, money, materials and men, a very indifferent engineer can eventually construct great and difficult work. The high essentials of the art of engineering consist, however, in executing the work with the maximum rapidity, safety, economy, efficiency and durability, and it is the ability to secure results that are best possible in every way which distinguishes the master engineer.

While engineering, especially construction engineering, is essentially a creative art, its operations are seldom sudden or radical, and it is largely founded on well demonstrated, mathematical and scientific and mechanical principles steadily developed and applied to produce standard materials, methods and operations that are well proven and cover so wide a range that their judicious combination, selection and revision, modification, or extension leaves little of the present field of requirements uncovered.

The able engineer achieves his success by the thorough investigation, accurate and complete analysis of the problem and the application to it of the most approved and up-to-date practice, rarely attempting experiments or risking uncertainties; always providing in advance for every reasonable contingency and equipped with a reserve of supplies and resources to meet any possibility occasioned by unforeseen conditions or remote contingencies.

It is a wise combination of patient detailing and absolute thoroughness and accuracy of routine that brings the best results rather than careless brilliancy that unnecessarily tries new methods and ventures into strange paths

Established precedent is therefore of prime importance in construction work and the official who is responsible for a variety of public work, as are municipal, state and federal authorities, cannot be expected to be individually conversant with all the elaborate features of many different kinds of construction. It is both his duty and his privilege, in cases of unusual difficulty or importance, to summon to his aid, experts in a special field to solve the problem in accordance with the indications of previous results. This is especially true in the building and rebuilding of large bridges under difficult requirements of traffic, navigation or local conditions. Except in a very few cities such for instance as New York, or those existing on opposite banks of large rivers, bridges are incidental rather than universal units of public works, while in the railroad systems they are among the most important and numerous of the structures, and are consequently in charge of highly trained specialists in their design and construction. These men and the independent experts form a class by themselves and are by way of almost achieving miracles in their chosen field. Their cooperation or the imitation of their successful work is, therefore, a proper and necessary resource for large problems of municipal and highway bridge construction where the application of their methods instead of the efforts to secure independent or novel operations is often likely to effect a great saving of time and money and promote the convenience and safety of the public.

The method of reconstructing two long spans of a great railroad bridge, which is described on page 345 provided equally for traffic and navigation, safeguarded against floods and assured safe and reliable work where great danger, delay and expense might have resulted from some other treatment of the problem.

In this great structure, three radically different plans, each founded strictly on sound practice, but offering a novel combination of methods, were approved for the different river spans, as described in this and other articles in Public Works, besides a wholly different and unusual method of replacing the shore viaduct. While specifically railroad work this is very applicable to municipal and highway work and merits the attention and the appreciation of engineers and officials interested in it.

Help Improve Transportation

The greatest difficulties now encountered by construction interests in this country are labor materials and transportation. Improvement in the condition of any one will greatly help increase production and promote lower prices that will rapidly improve business conditions of all sorts and make possible a return to safe and prosperous business.

We are still suffering the dislocation of transportation service due to war conditions and to the impaired and depleted equipment of the railroads who have not enough rolling stock and whose cars have been returned from government control in bad condition. It is impossible to get enough new cars quickly to fill demands and serious congestion and delay of freight results. A study of the official records shows, as noted in another column, that at present the cars are actually transporting freight little more than 9 per cent of the time, while more than 22½ per cent is occupied in loading and unloading it and the remaining 68 per cent includes a very large amount of unnecessary waste time. Apparently, therefore, at least one-third of the total time might be added to that now usefully employed by the cars which would just about double their present efficiency. About five hours a day is now occupied in loading and unloading and in waiting for loading and unloading and if only one hour of this time was saved and applied to transportation, the result would be a 10 per cent increase of freight movement without involving any extra expense for new equipment.

It is highly important that every large shipper or receiver of freight should realize the significance of this fact and place his orders so as to permit the utmost concentration, continuity and rapid completion of loading and be ready to unload and release the cars without any delay whatever. This would in no way increase his expenses but on the contrary would effect an independent saving. One way in which it can be materially facilitated is by the installation of handling machinery wherever applicable and justified by the amount of business. Another way is by preparation and strict adherence to schedules of operation and the employment of trained men held strictly responsible for the work.

Recent Progress in Sanitary Engineering

As a part of the annual report for 1919 of the New York State Health Department, there is published a report of the Division of Sanitary Engineering, which contains a number of interesting summaries.

First is given a brief statement of the work of the Division, which is stated to comprise "the examination and approval of plans for sewerage and sewage disposal; the investigation and control of the sanitary quality of public water supplies; the investigation of public nuisances; the examination under order from the governor into conditions of nuisances affecting life and health; the examination of the sanitary conditions of state institutions; the inspection of sewage disposal plants; the investigation of the construction and operating efficiency of milk pasteurizing plants; the examination and approval of plans and expenditures for county mosquito extermination commissions; assistance to boards of supervisors in the matter of water supply and sewage disposal at county tuberculosis hospitals; the investigation of typhoid fever outbreaks, due to waterborne infection; consulting advice of a general nature to municipalities, corporations and individuals in regard to water supplies, sewage disposal and general sanitation; and educational and research work so far as possible within resources available."

WATER SUPPLY AND SEWERAGE.

Concerning advance in water supply and sewage disposal, the author of the report states:

"Broadly speaking, the development of scientific knowledge and experience during the year in regard to both water supply and sewage disposal has been substantial. In the water supply field considerable additional knowledge has been gained in regard to disinfection of water generally and particularly under military and other emergency conditions. In this latter field also we witness the application of new methods of filtration, such as the drifting sand filters at Toronto, and the use of the pressure sedimentation tanks in connection with pressure filters.

"In the sewage disposal field we find a corresponding added knowledge in purification methods, particularly in regard to preliminary treatment.

Self-cleansing sewage screens, more uniform and effective sedimentation velocities in tanks, mechanical means of sludge removal in sewage tanks, and more economical and effective methods of applying air and operating tanks in the "activated sludge" process, are lines along which research and experimentation have been successfully carried on during the year. So important in fact has been this acquisition of knowledge that there is good reason to believe that some of these new devices will, on account of their simplicity, efficiency, or economy, supplant in part at least present methods of sewage treatment."

Attention is called to the increased number of water purification plants installed in the state during the year 1919. New filter plants or additions to existing plants were established at five cities. Chlorination plants or additional units were installed at eight cities. With the addition of these plants purified water is now served to nearly 7,000,000 inhabitants of the state or 64 per cent of the total population. The significance of these improvements is illustrated by the fact that, while the typhoid rate in the state in 1906 (the year the Engineering Division was established) was approximately 20 per 100,000 of population, it had been reduced to approximately 3.5 at the close of 1919.

Concrete Sewer Standard Specifications

Specifications for sewer forms and for reinforced concrete pipe recommended by the American Concrete Institute.

(Concluded from page 337)

Concrete Sewer Forms.

The standard specifications recommended by the Committee of the American Concrete Institute provide that:

Section 50. Forms for slabs or very flat arches, as in box sections or roofs of special chambers, shall remain in place for at least seven days. No load shall be placed on the concrete for fourteen days, and then only with permission.

ARCH FORMS.

Arch forms shall not be slackened until the backfilling has been carried to a height of at least one foot above the top of the arch and tamped. Arch forms shall remain in place for forty-eight hours when conditions are most favorable for the hardening of the concrete and for a longer time, as may be directed, during inclement weather, or where unusual conditions exist. Permission for dropping center must be secured for each arch unit.*

BACKFILL.

Backfill, over and around arch sewers, shall be placed as soon as possible after the cement has set. The filling up to a plane two feet above the top of the arch shall be made from the best earth, and shall not contain a sufficient amount of large stones as to allow the pieces of stone to become wedged. It should be filled in layers of not over six inches and carefully tamped.

If the remainder of the backfill is dumped from buckets, the contents of the buckets should not be allowed to fall more than five feet, unless the impact is broken by timber grillage. Bracing should generally be removed only when the trench below it has become completely filled and every precaution shall be taken to prevent any large slips of earth from the side of the trench onto or against the green arch. All voids left by withdrawal of sheeting shall be immediately filled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as may be directed.

Manufacturing and Testing Reinforced Concrete Sewer Pipe.

The standard specifications recommended by the Committee of the American Concrete Institute provide that:

Section 53. Reinforced concrete sewer pipe shall be made circular or egg shape in cross-section and circular pipe made in sizes from 24 inches to 96 inches inside diameter. Opposite diameters shall be true with a permissible variation of not more than three-quarters of one per cent.

Section 54. Reinforced concrete sewer pipe shall be in sections of not less than 3 feet in length, and ends so formed that when laid together and cemented they shall make a continuous and uniform line of pipe.

Section 55. The provisions of Sections 1 to 11, inclusive, specifying materials for monolithic sewers, shall apply to materials for concrete pipe, and the provisions of Sections 20, 21, 22 and 26 shall apply to its manufacture. All concrete shall be proportioned 1 bag Portland cement, 2 cu. ft. fine aggregate, 4 cu. ft. course aggregate.

FORMS AND CURING.

Section 56. All pipe shall be made in forms composed of sheet steel cores and casings, and cast-iron bottom and top rings which form the joint. The forms shall be rigidly held together, and the core and casing so placed as to insure uniform wall thicknesses.

The top rings, cores and casings shall not be removed from the pipe until the concrete has obtained its final set.

Pipe shall not be lifted from the bottom rings until the concrete is from 60 hours to 72 hours old.

After the cores and casings have been removed from the pipe they shall be kept constantly and thoroughly wetted by sprinkling with water at least three times a day until they are removed from the bases and yarded. After being placed on the yard the pipes shall be sprinkled thoroughly at least three times a day until they are six days old.

All pipes shall be marked with the date of their manufacture, and no pipe that is not 14 days old will be permitted to be laid unless it has been steam cured.

STEAM CURING.

Pipe may be cured by the use of wet steam in the following manner: After the pipes have been cast they shall be covered with canvas or other material known as steaming jackets and wet steam be turned into these jackets for one day after casting. Then the casings and cores may be removed and the steam again applied in the same manner for one day. After this has been done the pipes may be removed from the bases and yarded, no other curing being necessary. Steam cured pipes may be laid when they are six days old.

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*For small arches, six feet or less, and under the most favorable conditions, forms may be dropped in 24 hours.

TESTS.

Section 57. Any or all of the following tests may be applied to samples selected by the engineer from the pipe delivered on the work. For the purposes of making such tests, the contractor shall furnish and deliver, when directed, and at the place required, five lengths of each size pipe used in the work.

Section 58. (a) When supported at the bottom upon a knife edge one inch in width, in such a manner that an even bearing is provided throughout the whole length, exclusive of the bell, and load is applied at the crown uniformly through a similar knife edge, the various sizes of pipe shall withstand, without signs of distress, the following loads in pounds per lineal foot: 24-in., 2,149 lbs.; 27-in., 2,369 lbs.; 30-in., 2,583 lbs.; 33-in., 2,830 lbs.; 36-in., 3,080 lbs.; 39-in., 3,300 lbs.; 42-in., 3,521 lbs.

(b) Sand bearing loads equivalent in value to the knife-edge loads, 24-in., 3,070 lbs.; 27-in., 3,370 lbs.; 30-in., 3,690 lbs.; 33-in., 4,040 lbs.; 36-in., 4,400 lbs.; 39-in., 4,710 lbs.; 42-in., 5,030 lbs.

(c) When supported upon a sand saddle which extends the full length of the pipe, exclusive of the bell, and whose upper surface fits accurately the outer curved surface of the pipe, and whose width is equal to an arc of fifteen degrees, in such a manner that an even bearing is provided throughout the whole length, and the load is applied at the crown uniformly through a knife edge one inch in width, the various sizes of pipes with diameters greater than 42 inches shall withstand the following loads per lineal foot: 48-in., 3,800 lbs.; 54-in., 4,400 lbs.; 60-in., 5,000 lbs.; 66-in., 5,500 lbs.; 72-in., 6,000 lbs.; 78-in., 6,500 lbs.; 84-in., 7,000 lbs.; 90-in., 7,500 lbs.; 96-in., 8,000 lbs.

ABSORPTION TEST.

Section 59. The specimens for absorption tests shall be sound pieces with all edges broken, and may be from pipes broken in the crushing test. One specimen shall be selected from each pipe broken in the crushing test, or may be taken from other pipes. They shall be from 12 to 20 square inches in area, and shall be as nearly square as they can be readily prepared. They shall be free from observable cracks, fissures, laminations or shattered edges.

DRYING.

Preparatory to the absorption test, the specimen shall be first weighed and then dried in a drier or oven at a temperature of not less than 110 degrees C. (230 degrees F.) for not less than three hours. After removal from the drier the specimen shall be allowed to cool in dry air to room temperature and then weighed.

If the specimen is comparatively dry when taken, and the second weight closely agrees with the first, it shall be considered dry. If the specimen is wet when taken it shall be placed in the drier for a drying treatment of two hours and reweighed. If the third weight checks the second, the specimen shall be redried for two-hours periods until check weights are obtained.

WEIGHING.

The balance used shall be sensitive to five-tenths (0.5) grams when loaded with 1 kg., and weighings shall be read to the nearest gram. When other than metric weights are used the same degree of accuracy shall be obtained.

IMMERSION.

The specimen, after final drying, cooling and weighing, shall be placed with other similar specimens in a suitable wire receptacle, packed tightly enough to prevent jostling, covered with distilled water or rain water, raised to the boiling point, and boiled for five hours, and then cooled in water to room temperature.

The specimen shall be allowed to drain for one minute, and, the superficial moisture having been removed by towel or blotting paper, the specimen is then placed upon the balance.

The test result shall be calculated as percentage of the initial dry weight.

The results shall be reported separately for each individual specimen, together with the mean for all the specimens from the same shipment of pipe.

Each specimen shall be marked so that it may be identified with the pipe used in the crushing test from which the specimen was taken. The marking shall be applied so that the pigment shall not cover more than one per cent of the total superficial area of the specimen.

The maximum allowable absorption shall be 12 per cent.

Delaware River Bridge and Tunnel

Vigorous efforts are being made by the Mayor of Philadelphia, endorsed by the Governor of Pennsylvania, to secure the construction of a long span bridge across the Delaware River from Philadelphia to Camden. The minimum cost, exclusive of the expensive approaches, is estimated at $20,000,000, and the construction is considered assured. In addition to the bridge, the Mayor also insists on the necessity for a supplementary tunnel that is needed to help care for the present traffic of 46,000,000 passengers annually on the crowded ferry system and for the increasing traffic of the future.

Stockton, California, Proposes a $5,000,000 Inland Harbor

According to plans submitted to the Stockton City Council by Sherman A. Jubb, engineer, provision is made for the construction of a great freight and passenger terminal and large improved docking facilities that will cost about $5,000,000 including $2,000,000 from a Federal government appropriation now pending.

The work will require the development of the present Stockton channel now used for docking river steamers to adapt it for deep water vessels; the filling of the lower end of the present Mormon channel to provide for new industrial developments, and the cutting of a new outlet for it which will also serve as a waterway for smaller vessels heretofore using the Stockton channel; construction of municipal railroad yards on north and south of the Stockton harbor; construction of a belt line railroad; and the dredging away of Weber Point, providing a turning basin for vessels of 10,000 tons. The plan is endorsed by the city commissioners and, if adopted, the expense will be paid by the city, except as provided for by government appropriation.

Utah Irrigation and Water Improvement Scheme

It is proposed to construct dikes on the east, south and north shores of Utah Lake to increase the storage capacity for the rainfall on 2,000 square miles of mountain and valley. This, it is estimated, will furnish 253,000 acre-feet of water now flowing into the Utah Lake and the Jordon River, and will suffice for the reclamation of 204,160 acres of land in Cedar Valley and in Utah County, besides the retaining of 30,000 acres in Rush Valley, 20,000 acres in Tooele County, 38,000 acres on the east side, and 20,000 acres on the west side of Salt Lake Valley. The water will also be made usable for domestic purposes by the diversion of all alkaline waters.

The diversion works will involve the construction of 60 miles of canal, 250 feet wide at the top, 100 feet wide at the bottom and 20 feet deep, together with pipe lines from 3 to 8 feet in diameter and pumping equipment at an estimated expense of $6,000,000 to $8,000,000.

The cost of delivering water on the ground will be from $40 to $50 per acre and much of the land is already under cultivation with a present value of $75 an acre, which it is expected, when water is available, will immediately be increased to $200 per acre. Data for this scheme have been prepared by Chas. S. Brown, engineer, Walker Bank Building, Salt Lake City.

The Labor Field

No large supplies of unemployed laborers available in the New York district. Demand is greater than supply. New methods eliminate large gangs in many kinds of work. Forces recruited largely by individual solicitation.

In and around Greater New York conditions have changed mightily since a few years ago when a thousand men or more could be had, on short notice, delivered in groups or regiments.

Scarcely more than half a dozen years ago heavy construction work in general was handled by carpenters, masons, bricklayers, steel erectors or housesmiths, dock builders, hoisting engineers and a sprinkling of special mechanics together with a large body of laborers for excavating, concrete work, floating gangs and miscellaneous services. The latter kinds of work have been specialized, subdivided, and classified until now there are many distinct grades each claiming privileges and making demands that frequently overlap so as to cause difficulty, confusion, and sometimes strife.

A much smaller proportion of the ordinary work is now considered as labor and the jealous distinctions and restrictions cause much delay, extra expense and duplication of work. These with other conditions have been important factors in developing not only different types of design but in the perfection and installation of much more power machinery to take the place of hand labor and improved appliances for conveying and handling material so that a given piece of work is now accomplished with less men than in former times.

Another development of the present situation is due to the fact that the long cessation of non-essential construction during and subsequent to the war has practically eliminated railroad and terminal work that formerly employed large forces for excavating, grading and other heavy operations and bulk requirements. There are now, and recently have been, few or no railroad extensions and terminal works, canals, dams, reservoirs and the like have been restricted as much as possible, harbor and river improvements postponed, and the men that were occupied in such employment have been so thoroughly dispersed that they are not now available in large bodies as formerly.

Some kinds of work have been necessarily prosecuted such as the completion of great aqueducts and water supplies under construction, necessary sewers and the like, and in these cases large and rapidly increasing use has been made of power equipment such as trench machines, dragline scrapers, standard and special steam shovels, loading, unloading and conveying apparatus, and other plant reducing the amount of hand work.

Formerly in New York City and in many other places an abundant supply of skilled and unskilled labor could always be depended upon to apply on the job for work, the turn-over was relatively small, and no difficulty was obtained in hiring men at current prices. When one of the recent extensions of the subway system that has now been in operation a year or two, was contracted for the contractor's engineer estimated for a possible increase of nearly 100 per cent in wages to safeguard against any loss and in so doing was vigorously opposed by the contractor, who reluctantly yielded to the engineer's judgment. For some months things went well with abundance of good labor until the work was interrupted by a big strike, after which there was a remarkable scarcity of labor and great difficulty was obtained in securing a minimum complement of men. There were no applicants for the job, and European hostilities being then well under way the exodus of foreign labor was so great that the small supply of competent men was completely exhausted and the only help available was that secured by hiring petty leaders who, for foremen's pay or perhaps a bonus in addition, would agree to furnish a gang of one or two dozen laborers that invariably proved to be old, feeble, crippled or otherwise very inefficient, yet demanded and received much increased wages. These men would soon begin to melt away and the whole gang would soon have to be replaced, involving much delay, dissatisfaction and multiplied expense for inferior services. The situation finally became so grave that this engineer made revolutionary changes in his manner of conducting the work, devised entirely new apparatus for handling it, and by his personal initiative and ability eventually succeeded in saving a situation that otherwise might have meant little less than ruin to the contractor. There are many similar examples, but not all of them terminated as favorably.

Formerly if a large force of men was needed promptly it was the universal custom to apply to one of many "Padrones," who could each control a crowd of foreign laborers and would deliver them on the job for so much a day per man, and who made fortunes on their commissions for labor and on the charges they collected from the men, many of whom could speak no English and were at their mercy. Today the padrones have almost or entirely disappeared from New York, so that an inquiry among several large employers of labor failed to locate a single padrone.

In the more responsible skilled classes of work such as foundation work, caissons, tunnel work and the like, the principal contractors have always found it necessary to retain a large and expensive standing organization with superintendents and a number of foremen and sometimes a few of the best workmen to form the nucleus for quickly selecting and training men for new jobs. These superintendents and foremen always had a following of the best laborers and mechanics with whom they kept in touch and who were ready to respond when new work was commenced. Sometimes on work of long duration and commanding high prices like caisson work, tunnel work, and other heavy construction, these men would travel half across the country to join a new job for their old employer. The same system still prevails as far as conditions permit, and at the present time men for new work in this vicinity are chiefly recruited by personal invitations from superintendents, foremen and assistants and by passing the word among the men themselves who so far as otherwise unoccupied and interested will respond in diminished numbers. These recruits are sometimes augmented by advertising in the daily papers, and wherever an employer with a deficiency of labor happens to know of a surplus in some other town or city, he may send a special agent to hire men there. Some employers keep up recruiting almost continually by agents traveling from place to place through the country and hiring such men as are available and desirable.

The great fact remains that the general balance of labor is reversed within recent years. During the war the exodus from this country very greatly exceeded arrivals, and even now the immigration is very far below what it was in previous times, and far below requirements, so that there is unquestionably a serious shortage of labor and a prospect that it will continue indefinitely. There is no doubt that the entire country, including labor itself, would be much benefited by a large importation of labor, particularly of common unskilled labor, that would relieve the more intelligent, expert and experienced men of rough work and thus permit them to have easier jobs and earn higher wages in more agreeable occupations. When this is accomplished, and when organized labor is held strictly accountable for the execution of its covenants and is reliable and responsible, and when honesty prevails so that each workers willingly gives an honest equivalent for his pay and production is increased instead of wilfully diminished, the labor question will be far on the way to a satisfactory solution.

Irrigation Notes

In order to reclaim for purposes of irrigation between 1,000,000 and 3,000,000 acres of land in southeastern Montana, residents will attempt to divert the water from the Yellowstone Lake which now finds its way to the Atlantic ocean by way of the Mississippi river. It is planned to place water on millions of acres of the 500 mile valley of the Yellowstone river. A campaign has been started to raise $50,000 for the preliminary work required before the construction of a dam at the point where the Yellowstone river leaves the lake can be undertaken. The construction of a dam will cost about $300,000 and it is planned to apportion the water in the river, organize irrigation districts and construct canals.

California is facing the most serious power and irrigation shortage in the history of the state, according to H. G. Butler, State Power Administrator. The precipitation this year has been less than fifty per cent normal up to date. If the present rate of water consumption is continued, the supply of water for power usage will be less than fifty per cent of the demand by August. It is planned to regulate the water for irrigation, eliminating for this year the rice growers of the delta lands.

The possibilities of irrigation are illustrated by a recent announcement in the local press that 508 acres of irrigated land in Des Moines County, Iowa, have just been sold in three large lots for a total price of $133,050, and that before the establishment of the drainage district, the value was only a few dollars per acre.

A movement looking toward a comprehensive survey of drainage and land clearing possibilities in Northern Minnesota has been initiated and steps taken to have a survey made of conditions.

Impounding the Colorado River

Former Secretary of Agriculture, Maine is said to recommend impounding the waters of the Colorado River in the Grand Canyon to provide for the irrigation of 1,500,000 acres of arid land, which it is claimed would be benefited to the amount of $100 an acre.

Such a scheme, like that of damming the Niagara Rapids should not be too seriously considered until adequate surveys have been made and authoritative engineers report on the safety, efficiency, and expediency of detailed plans of construction and operation. Even then any utilitarian interference that will materially deface either of these most beautiful of nature's magnificent beauties should not be tolerated until the economic necessity becomes far greater than it is at present likely to be.

Brazil Spending $50,000,000 on Irrigation

Preliminary work has begun on the construction of great irrigation canals in the drought-stricken section of Northeast Brazil, for the relief of which the recent Congress appropriated $50,000,000. It is planned to extend railroads into that section. The work is expected to be completed within five years.

Wood Block Paving

Discussion before the Western Society of Engineers brought out some points in the history of the development of this pavement. Walter Beuhler stated that bleeding was caused by the heavy oil used as a preservative in recent years, and that treatment with light oil and proper laying, both according to recent standard specifications, will prevent both expansion and bleeding, as well as decay.

The subject of wood block paving was discussed by the Western Society of Engineers at one of their recent meetings, the paper which formed a principal feature of the evening having been presented by Walter Beuhler, a representative of the Barret Company. The printed report of the meeting contains about equal amounts of discussion and of Mr. Beuhler's paper, showing the interest that was taken in the subject by the members.

Mr. Beuhler maintained that an examination of wood block pavements in the "Loop District" of Chicago showed that wood block was a good pavement, some of those in this district nine to twelve years old having by no means outlived their usefulness, although they have been subjected to the most severe traffic, most of the streets have double street car tracks, and, most severe treatment of all, the pavements were being constantly torn up for one reason or other.

In spite of this, he finds that the use of wood block pavements has fallen off very rapidly during the past five years, although a few cities like Minneapolis contine to use them. He did not pretend to explain this, but suggested that the high cost of the pavement has something to do with it, and also the fact that wood preservers found that they could secure better sales with less effort in other directions. Some of the opposition to wood pavements he believed was due to the swelling and bleeding which had become quite pronounced five or ten years ago, but which he believed could be overcome by proper treatment, which had only recently come to be understood and appreciated.

Concerning the decline in the use of wood block, Geo. W. Tillson, during the discussion, expressed the opinion that this was largely due to the improvement in other pavements in smoothness and noiselessness and in the much more general use of rubber tires which also conduce to these results on streets which were noisy with the old steel tires.

EARLY PAVEMENTS.

Supplementing Mr. Beuhler's statements with those contributed in the discussion by Mr. Tillson, it appears that when the first pavement was laid in about 1900 the blocks were impregnated with 20 pounds of a mixture of one-half creosote oil and one-half rosin. Specifications adopted about that time by New York City provided that the blocks should not absorb more than 3 per cent of water when dried at a temperature of about 100 degrees for 24 hours. (The first pavement laid in Boston is, we believe, still in excellent condition having carried a heavy traffic for 20 years.)

In a short time, however, the expense of using rosin became so great that it was thought desirable to substitute something else. The theory was that the creosote would preserve the block, while the rosin or its substitute would keep the creosote in so that it would not evaporate. Engineers concluded that if a heavier oil were used it might have this effect, and specifications of the Association for Standardizing Paving Specifications and of the American Society for Municipal Improvements. adopted in 1911, called for a heavy oil containing a large amount of tar. Mr. Tillson apparently believed that this heavy oil was effective in preserving the blocks but, according to Mr. Beuhler, the use of this oil was immediately followed by bleeding which became seriously objectionable and even intolerable in many cases

PREVENTING EXPANSION AND BLEEDING.

Mr. Beuhler stated that expansion can be eliminated and bleeding prevented without the use of a heavy tar or rosin, but by the treatment of the wood itself. He described this as follows:

"Southern pine, which is the wood most generally used in the central west and eastern sections, is, as you no doubt know, made up of elongated spindle-like fibres, closed at the ends and having hollow centers. The walls are pierced with small openings. Now it is an interesting and important fact that the cell walls will not absorb creosote except in very small amounts. While on the other hand they will absorb water, and in fact it is the water content of the fibre wall that has a direct bearing upon the contraction or expansion of the wood.

"A saturated piece of wood is expanded to its maximum. As moisture is evaporated no change in size takes place until the moisture is out of the cell structure, or hollow spaces in the fibres, and begins to come out of the fibre wall itself. This point is called the fibre saturation point. Any decrease of moisture in the cell wall will immediately result in contraction. A creosoted block therefore contains more or less moisture in the cell walls, depending upon its seasoning before treatment, and creosote oil in the cell openings.

"The creosote oil in the cell openings and on the cell walls acting as a waterproofing paint, retards, not entirely preventing, the evaporation or absorption of moisture. A heavily treated block exposed to the sun will lose enough moisture to appreciably contract and will when again subjected to moisture absorb it and expand. A block treated to refusal, which in southern pine might mean twenty-eight pounds per cubic foot, would of course be more water-proof than one treated with sixteen pounds per cubic foot. But as the creosote acts as a paint, it is not necessary or advisable to have a surplus of oil in the cell openings, approximately the same effect being produced by a uniform distribution of a smaller quantity of oil. In other words, it is better to regulate the treatment so as to get a better distribution of a small quantity of oil than to specify a large quantity, the larger quantity tending to produce bleeding. Sixteen pounds of oil per cubic foot of timber has been determined to be the most economical amount.

"Now as to the effect of quality of oil on expansion. It goes without saying that the heavier the oil the better waterproofing paint it will be. The heaviness, however, is limited by the necessity of uniform distribution throughout the wood and the practical time limit required to obtain this uniform distribution. Again it resolves itself into a question of treating methods rather than quality of oil.

"Now just what are the treating methods to which I refer? They can be stated briefly. First, the preparation of the wood for the injection of the preservative; second, the proper injection of preservative, regulating both the time and amount of pressure; and, thirdly, the cleaning of the surface of the blocks by steam and vacuum.

"The specifications for treatment as adopted by the American Wood Preservation Association reads as follows:

"Timber may be either air seasoned or green, but should preferably be treated within three months from the time it is sawed. Green timber and seasoned timber shall not, however, be treated together in the same charge. The blocks shall be treated in air-tight cylinders with the preservative heretofore specified. In all cases, whether thoroughly air seasoned or green, they shall first be subjected to live steam at a temperature between 220 and 240 degrees Fahrenheit, for not less than two hours nor more than four hours. Afterwards they shall be subjected to a vacuum of not less than twenty-two inches, held for at least one hour. While the vacuum is still on the preservative, oil heated to a temperature of between 180 degrees and 220 degrees Fahrenheit, shall be run until the cylinder is completely full, care being taken that no air is admitted. Pressure shall then be gradually applied not to exceed fifty pounds at the end of the first hour, nor one hundred pounds at the end of the second hour, and then maintained at not less than one hundred pounds, nor more than one hundred fifty pounds, until the wood has absorbed the required amount of oil. After this, a supplemental vacuum shall be applied in which the maximum intensity reached shall be at least twenty inches, and shall continue for a period of not less than thirty minutes. If desired, this vacuum may be followed by a short steaming period.

"Now the important factors in this specification, as outlined, are: "First, the condition of timber before treatment. It states that the timber may be either air seasoned or green, but in either case it shall first be subjected to live steam at a temperature between 220 and 240 degrees Fahrenheit, for not less than two or more than four hours. Now have in mind that this specification was drawn up with the object of obtaining a uniform distribution of the oil in the block—and that southern pine can be impregnated with about twenty-eight pounds per cubic foot—and we are trying to impregnate it with sixteen pounds of oil to the cubic foot, approximately half the amount—and uniformly distribute that smaller amount throughout the block. If the blocks were all thoroughly seasoned and the oil injected in that seasoned condition and the treatment stopped at sixteen pounds of oil per cubic foot we would then find the sap wood thoroughly saturated and the heart wood barely treated. In other words, thoroughly seasoned the sap wood is far less resistant to impregnation than the heart wood. On the other hand, if the timber were green and not steamed to permit of the impregnation of the sap wood, the sap wood, which is saturated with moisture and in a green state more resistant than heart, would receive less oil and the heart wood receive more oil, resulting in the rotting of the sap wood, so that it is important that, whether the timber be seasoned or green, it be first steamed in order to, in a measure, equalize the resistance of both the sap wood and the heart wood. Then, of course, after the steaming period, it calls for the vacuum, which is simply to remove the surplus moisture from the block. Then follows this clause: 'Pressure shall then be applied after the cylinder is filled with oil gradually, not to exceed fifty pounds, at the end of the first hour, nor more than one hundred pounds at the end of the second hour.' That is one of the most important clauses in the specification. If a high degree of pressure were applied rapidly the sixteen pounds of oil per cubic foot, which is approximately half the quantity which could be injected, would go into the less resistant blocks, treating them more heavily than the more resistant blocks, and it would also fill the outer surfaces of the block and not be uniformly distributed throughout the block, so that the two factors—first, putting the wood in condition for impregnation, and then the uniform pressure slowly applied—are both essential to a uniform distribution. The third clause—steaming and vacuum — are not absolutely necessary, but if an oil has been used repeatedly it accumulates more or less sawdust and dirt, and a clearer block will result if the steaming and vacuum practice is followed. In other words, it has a washing effect.

"Careful observance of the specifications just described is the only preventive for bleeding."

Referring to the method of laying the blocks, Mr. Beuhler stated that the early practice was to lay them on a concrete foundation with a sand cushion, but during the past seven or eight years most of the cities using blocks have substituted a mortar cushion composed usually of four parts sand to one part cement, moistened just enough to spread easily. This prevented the objectionable shifting of the sand cushion which sometimes occurred, but it stil held moisture, which the block could absorb from the bottom, expansion resulting.

BITUMINOUS PAINT METHOD.

Better than this, he believed, was the bituminous paint method which consisted in finishing the surface of the concrete base quite smoothly and painting it with a coat of a tar preparation not exceeding 1/8 of an inch thick. This was practiced abroad ten or twelve years ago, and in a few isolated cases in this country about the same time. One sample can be found in St. Louis and another in the little town of St. Boniface in Canada. The earlier practice was to lay the blocks on the paint while it was still hot, but later practice is to allow the paint to cool. The latter has the advantage of permitting an inspection of the surface of the block before the pavement is filled, removing any of the blocks if necessary for final inspection. The object of the paint coat is not to take care of any irregularities in the surface of the concrete, but to seal the bottom of the block. The blocks are sometimes rolled after having been laid to press them into the paint coat, but this will be effected sufficiently by traffic.

Although contractors objected that this method of construction would add to the expense because of the necessity of making a smooth finish to the concrete base, it was found that, if a concrete base proportioned about 1:2½:5 is worked the same as a one-course concrete pavement and finished with a long-handled float or a small roller, sufficiently even surface can be produced. In Minneapolis, where this construction is standard, the engineer in charge uses a 3-inch pipe about 15 feet long filled with sand and operated on wooden templets, the tops of which are at the grade of the finished concrete. By these means he secures an even surface both rapidly and cheaply.

It has been found that this method of construction is cheaper than the mortar bed construction, because the saving in sand and cement required for the mortar more than offsets the cost of the thin coat of pitch used and the labor of preparing the concrete surface. He reported that one city has effected a saving of from 10 to 15 cents a square yard.

JOINT FILLING.

While the bituminous paint coat seals the bottom of the block, it is necessary also to fill the joints of the pavement in order to seal the sides of the block. Even with the improved method of treating and laying block pavements, there are still cases of bleeding, but most of these are probably due to an excessive amount of filler. The practice of filling the joints by smearing pitch back and forth on top of the block results in a surplus amount of filler on top of the block, which during hot weather gives the impression of bleeding. The filler should be heated to the proper temperature and then poured on the pavement and squeezed in with a squeegee pushed in one direction only, the joints of the pavement being filled from 1/3 to ½ full. Upon cooling, the pitch contracts and remains about an inch from the bottom, which is sufficient, for the object of the filler is not to fill the space between the blocks but to paint the sides of the block, and a small amount in the bottom of the joint, upon expansion, is queezed up and results in distributing it over the sides of the block.

Mr. Beuhler emphasized the fact that traffic, by compacting the top of the block, tended to waterproof it on the top surface, and that where traffic was not heavy, considerably more care must be taken in the treatment of the block and in the construction of the pavement to effect thorough waterproofing.

River and Harbor Notes

It is estimated that the development of the St. Lawrence River between Montreal and Lake Ontario to make it navigable for deep draught ocean steamers will cost more than $50,000,000 and the development of the unused water power amounting to about 2,000,000 h. p. would cost about $200,000,000 for work now under consideration by the International Joint Committee Commission of Waterways.

Arthur A. Stiles, state reclamation engineer of Texas, and George E. Kessler, Dallas city planning engineer, have completed plans for straightening the Trinity river bed, constructing levees and improving reclaimed lands. The plans contemplate levees 30 feet in height and 2,000 feet apart. Viaducts will be constructed across the 2,000-foot channel wherever necessary to facilitate travel.

The river Des Peres project, to be provided for by a proposed municipal bond issue, will recover for the city of St. Louis about 2,000 acres of land. The river channel will be straightened and depened and in addition municipally owned tracks will be laid. The plan provides for the elimination of a menace to health, life and property and affords an opportunity for development.

The Brooklyn Chamber of Commerce is making renewed efforts to persuade Congress to authorize the construction of a 1,000-foot dry dock for the Brooklyn Navy Yard. Dry docks of this size are available in Boston, Philadelphia and Norfolk, but in New York there is none larger than 725 feet long, although there are now 15 merchant vessels plying from this port that are of greater length, besides battle cruisers under construction in the Brooklyn Navy Yard and elsewhere.

An Artificial Hydraulic Plant

An up-to-the-minute plan of juggling with millions and fascinating estimates is that recently inflicted on the public by the proposal of a ship and water power canal to deliver the waters of Lake Ontario to the Hudson River by way of an incision through "a ridge of earth and along the Mohawk River and Lake Oneida to the Hudson, thus providing for the use of as much water as is desired from the Lake Ontario run-off of 255,000 cubic feet per second at a head of nearly 245 feet, the elevation of Lake Ontario above sea level."

It is estimated that the scheme would only cost the trifling sum of $500,000,000, and that it would produce 4,000,000 h. p.—years of sable energy at $40 per horse power per year, which easily figures to the handsome sum of $160,000,000 a year, thus paying for the whole outlay plus an insignificant surplus of $14,000,000 in four years.

It is true that the ship canal from the south shore of Lake Ontario would have some pretty heavy excavation to get over the summit but this need give no anxiety since after cutting to as great a depth as is profitable, the water can be coaxed to flow over the top of the rocky ridge by the installation of "a battery of huge automatic, high efficiency, direct action, gas power pumps that have of late been invented and improved; so that an enormous mass of water can now be profitably elevated to a plane where it can flow over the top of such rock encountered between Lake Ontario and the Hudson River as it is not economical to remove." The pumps in question "are the simplest and most durable pieces of high power mechanism in use today and for every horse power exerted through them in uplifting water from the lake, there would be a gain from the fall of the same to the sea level of over 100 per cent."

Laying 30-Inch Submerged Pipe With Divers

At Queensborough, Tasmania, 700 feet of 30-inch riveted steel pipe was laid by divers at a maximum depth of 26 feet below the surface of the water.

Sections of the pipe 48 feet long with flanged ends were rivited up on shore parallel to the water line, the ends temporarily closed with wooden bulkheads, the pipes rolled down inclined skids to the water and towed to position over a rip-rap foundation 3 feet high previously deposited on the mud bottom between alignment piles 100 feet apart.

The pipe sections were attached to tackles suspended from cantilevers on an 18 x 36-foot scow and operated by hand windlasses. The bulkheads were removed and the pipes were lowered to position on the rip-rap where the successive sections were bolted together by divers, who also set over the pipes, anchor chains 100 feet apart with the ends attached to concrete blocks sunk in the mud on each side of the pipe. The pipe was covered with a broken stone fill on top of the rip-rap and the side piles were removed, completing the work.

Repairing Decayed Trestles

A committee of the American Railway Bridge and Building Association, in reporting on renewals and repairs for timber trestle viaducts, says that when one-third or less of the piles in the bents are in bad shape, satisfactory repairs can usually be made by cutting off in solid material to a depth of 4 feet below ground line and setting on the old pile a post, spliced to it with four 3-inch slabs.

Where entire bents are to be removed, the new bents should be framed without a cap, set up and made ready to slip in as soon as the old piles are cut off. In other cases, new piles may be driven and sawed off alongside the old bents, after which the latter is cut out and the new bents pulled into place on the new piles.

New Design for an Asphalt Road

The author proposes a design for using sheet asphalt on highways, with concrete shoulders; also for constructing this in successive half-width sections.

By Hugh J. Fixmer

The character and volume of traffic now using the through route highways approaches and even exceeds the traffic on the typical city street. It appears obvious that the type of pavement that has proved satisfactory for city streets might be successfully employed on heavily travelled roads. We have passed through an era of long experimentation in the design and construction of roads and pavements. We have learned many things. New designs must be based on the lessons learned from past failures, as well as the triumphs of successful experience. There are certain basic facts that the designer of road structures must observe. The effect of the paved surface on the user is as important as the effect of the traffic on the pavement.

The fundamental purpose of paving is to provide a smooth surface for the traffic. A pavement is judged by its surface. The pavement surface must prove safe and comfortable to use, must be efficient, economical and present a good appearance.

Materials of construction must be used to their best advantage if efficient and economical results are to be achieved. The sub-grade must be given serious consideration in connection with the choice of type of construction and the determining of the necessary thickness of the base. To secure uniformity, the thickness of the accepted base may be varied to compensate for the poor sub-grade or inadequate drainage. As a general rule, in order to withstand loads and impact a macadam base must be approximately twice the thickness of a good concrete base. Many of our new roads of monolithic construction are disfigured by longitudinal cracks.

An irregular formed crack is a source of weakness, shortens the life of the pavement, adds to maintenance cost and presents an ill appearance. In order to provide against longitudinal cracking due to the effect of impact and frost action, it can be shown that the thickness of a monolithic slab must vary approximately as the width of the slab or road. The thickness at the center should be about one-twentieth of the width of the slab. The tendency to build roads wider entails an increase in thickness, and therefore in cost, of monolithic slab roads, like concrete or monolithic brick.

The roadway on all important roads, due to the speed of vehicles and width of trucks, should be of permanent construction for a width of at least twenty feet, with durable shoulders at least four feet in width, or temporary shoulders at least six feet in width.

Fig. 1 shows a typical monolithic road as recently built. The center thickness should be twelve inches and the shoulders, being of earth, six feet wide.

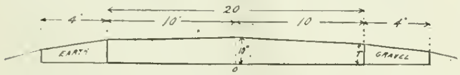

FIG 1
TYPICAL CONCRETE OR BRICK ROAD.

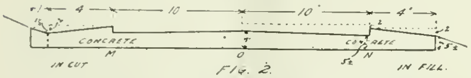

FIG. 2.
PROPOSED CONCRETE BASE AND CURB-SHOULDER

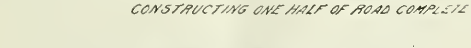

FIG 3
CONSTRUCTING ONE HALF OF ROAD BASE. (½ open to traffic)

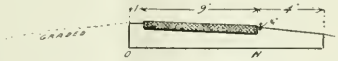

FIG 4
CONSTRUCTING ONE HALF OF ROAD COMPLETE

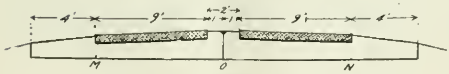

FIG 5
COMPLETE ROAD. ONE HALF BUILT COMPLETE AT A TIME.

A new type of road construction has been evolved based on the requirements of modern traffic and past experience in the construction of city pavements, which should prove economical and efficient. It is the standard sheet asphalt pavement adapted to road construction. It comprises a concrete base formed in one piece (Fig. 2) or in two parts (as shown in Fig. 3 and 4). A concrete "curb-shoulder" four feet in width is constructed monolithically with the base. The asphalt wearing surface, composed of a binder course ranging from one to two inches in thickness and a top course varying from one to two inches in thickness, depending upon the kind and volume of traffic, is placed in the recess formed between the curb-shoulders.

Referring to Fig. 2, the type of curb-shoulder shown on the right is used where the road is built on a fill or on level ground. The type of curb-shoulder shown on the left is used in cuts and acts as a gutter to carry surface water to a convenient outlet. Since only the surface of the curb-shoulders is exposed to use, very little finishing is required and the work can be done rapidly using a simple, uniform templet.

Since the asphalt wearing surface absorbs most of the shock or impact, the thickness of the concrete base proper, under normal conditions, need not average over six inches. It is proposed to use a 1-2-4 mix and a future crack in the area of the base or recess will not be seriously objectionable, since the asphalt surface completely covers and seals this area.

An asphaltic concrete can be substituted for the sheet asphalt surface, but the standard asphalt top is considered more efficient under modern traffic.

The roadway may be constructed one-half at a time, as shown in Fig. 3. This permits rapid construction and the use of either half of the road while the other half is being built. Fig. 4 shows the method of constructing one-half of the road on one side of the center line with the idea of completing the road at some future time. (Fig. 5.) Where funds are limited and prices are high and length of road is more important than width, this plan is recommended. The other half can be graded for use as a dirt road until funds are on hand or traffic required the building of the other half.

The curb-shoulders perform many useful things. They act as curbs to hold the resilent asphalt wearing surface in place and prevent the lateral displacement so often observed where curbs are not used. They assist materially in keeping the middle portion of the road in a dry state and thus reduce the danger of cracking and settlement within the area of maximum traffic. The curb-shoulders safely accommodate the infrequent or "turn-out" traffic, permit "parking" or repairing vehicles without interference with moving traffic. The full width of 28 feet of effective roadway will accommodate an emergency increase of traffic to three lines of moving vehicles.

The curb-shoulders, while relatively weaker than the selected wearing surface along the middle area of the roadway, are subjected to considerably less wear than the more comfortable and durable wearing surface, and should equal if not outlast the wearing surface proper.

Traffic tends to ride along the middle portion of the road because of the more comfortable (vertical) position of the vehicle, greater safety and usually cleaner conditions. After a light snowfall one may observe how little traffic uses other than the middle strip of roadway. To accommodate the traffic and induce it to spread over the roadway, the middle 20 feet should have a light crown. (See Fig 2.)

The curb-shoulders are given an increased slope to facilitate drainage and to discourage use by fast moving traffic.

The recess between the curb-shoulders is easily formed and affords a convenient means of properly curing the concrete base, since the curb-shoulders act as a container to hold water. The curb-shoulders are built integral with the base and being of durable material obviate the necessity of building and maintaining inferior shoulders of earth or gravel, as is now the custom. The old type of shoulder absorbs water and permits it to percolate under the slab, whereas the concrete shoulder keeps the area under the middle or heavy traction portion of the roadway comparatively dry.

In Fig. 5, the pavement is shown with a curb even with the asphalt surface for a width of two feet along the center line of the road. This is advantageous and not a defect. The traffic ordinarily will straddle this strip, and where the traffic is heavy the strip will operate to keep the traffic separate and in two lines, thus using the full width of the road. The center strip of concrete, because of its thickness, will withstand all cross traffic. The formed joint along the outer line dividing the two halves of the pavement, being vertical and in a true line, will require little or no maintenance.

This design, then, is a combination pavement devised to use suitable materials to their best advantage. The resilent asphalt surface located along the area of maximum traffic absorbs impact, is waterproof, is easy on the eyes, gives low traction, is easy to repair or replace, and easy to clean. The curb shoulders, being white in color, add to safety of travel at night, and are of ample strength to accommodate the occasional traffic using them. It is confidently believed that this adaptation of a time-tested city pavement to road or highway use will prove to be more efficient, economical and durable as a paved surface, and more safe and comfortable to the traffic using it, than other types now in use.

Ten Years of the Chicago Plan Commission

The Chicago Plan Commission, on the tenth anniversary of its creation, has issued a resume of the accomplishments of a decade, during which time it contributed so much to making Chicago a clean, beautiful and well developed metropolis.

Twelve basic features of its program are enumerated which are either under construction or advanced in procedure, either in the Board of Local Improvements or in the courts. They are: The Roosevelt road, widening and extension; the Michigan avenue, widening and extension; the west side passenger and freight terminal plans; the south shore lake front plans; the Illinois Central terminal rehabilitation; the widening of Western avenue; the widening and opening of Ashland avenue and Robey street; the South Water street widening and two-level connection with Michigan avenue; the acquisition of 14,254 acres of forest preserves by the Forest Preserve Commission; the improvement of the outer highway system.

Toward the cost of these improvements the people have voted $61,510,000 in bonds. Special assessments for Michigan avenue and Roosevelt road improvements have amounted to $8,125,239.89. The railway companies have agreed to spend $162,091,350 and the Forest Reserve Commission has expended $5,316,762.

Barring unforeseen events, all these projects should be completed during the next five years excepting the electrification of the Illinois Central and the extension of the lake front park plans south of 39th street.

The value of city planning is shown by the great increase in building construction in the improved zones, as on Michigan avenue and Roosevelt road. The same results may be expected from all other public improvements. The effect on the commerce and prosperity of the city will be most stimulating.

At a recent meeting of the county commissioners and auditors of the State of Minnesota at Minneapolis, the plan of C. M. Babcock, state highway commissioner, for road construction was almost unanimously approved. An attempt was made to pass a resolution substituting gravel for the proposed hard-surface roads, but the opinion prevailed that hard roads, by lasting much longer, would be cheaper in the end.

Oil Belt Power Company's Plant

Work has been commenced near Eastland, Texas, on the Leon River, just below the junction of its north and south forks, of a $2,000,000 power plant for the Oil Belt Power Company, which intends to distribute electricity through the oil fields for drilling, pumping and other purposes. The plant will cost about $2,000,000 and will include a concrete dam 25 feet high and 600 feet long impounding 1,600 acre-feet for boiler operation and cooling purposes. The power plant will be equipped with two 3,000 kilowatt steam turbines and boilers and will have a capacity of 8,000 h. p. Four miles of service track are being laid to the site of the plant for the delivery of materials and supplies from the Texas & Pacific Railroad. 500 men are required for the construction work.

Ouray Reservoir Opposed by Utah

Simon Banberger, Governor of Utah, has appointed a delegation to attend the convention this month in Los Angeles of the League of the Southwest to oppose the construction of the Ouray Reservoir that would submerge two Utah towns and thousands of acres of fertile land to save the Imperial Valley, California, from flood damages, objects which it is claimed could be equally well accomplished by the construction of numerous small reservoirs on the head waters of tributaries to the Colorado River.

Labor Efficiency Improving

The carefully classified unit costs on construction work that are kept by the Aberthaw Company, Boston, indicate that carpenters, masons, painters, and glaziers appear to be turning out as much work per hour as before the war. The 48-hour week, even with overtime does not turn out as much work as the old 54-hour week. Som e satisfaction is expressed that the men are actually busy during working hours.

Recent Legal Decisions

EXTRA WORK CLAIM NOT ALLOWED.

(Pa.) Where contract for construction of city reservoir provided a certain payment for rock excavation, and assumed that enough would be excavated to make facings and riprap for inner slope, for which contract fixed a certain price, it was insufficient, and contractor was required to blast rock elsewhere at additional expense, the city's contention that work was covered by the extra work clause, defining extra work or material as that for which no definite unit price was fixed in contract, was correct, and contractor had no right to abandon work because city refused to accept his construction that he was entitled therefore to price of rock excavation.—McKallip v. City of Altoona, 108 A. 408.

WAIVER OF ANNULMENT LIMITED.

(Pa.) Where a city waived its option to rescind or annul a contract for construction of a reservoir, because it was not completed within time limited, it did not thereby deprive itself of future right to annul or suspend contract for unsatisfactory work, and where contractor refused to do certain required parts of work it was not stopped from declaring a forfeiture, annulment, or suspension for sufficient cause other than the time of completion.—McKallip v. City of Altoona, 108 A. 408.

RETAINED PERCENTAGE NOT ALLOWED ON ACCOUNT OF DEFECTIVE PLANS.

(Or.) Where the work of a contractor to build a reservoir and waterworks system for a city was well done and in substantial compliance with its contract, and any unsatisfactoriness in the result was from a defective design, selected by the water commission, rather than from any fault of the contractor, the contractor can recover a retained portion of the price of the work, accepted by the water commission on recommendation of its engineer as required by the contract.—Oregon Engineering & Construction Co. v. City of West Linn, 185 P. 750.

SMALL UNFINISHED ITEM MAY PREVENT "SUBSTANTIAL PERFORMANCE."

(Pa.) Where a city reservoir was not completed until the facing and riprap on the slopes were in place, until which time even a small part of the reservoir might not be used, the doctrine of substantial performance had no place, in assumpsit to recover balance alleged to be due by contractor, who refused to complete contract.—McKallip v. City of Altoona, 108 A. 408.

INTEREST DUE ON RECOVERED PAYMENT.

(Or.) Where the contractor to build a city's water system and reservoir received its compensation in municipal bonds in advance, the city, when sued to recover a deficiency in payments, is entitled to a credit on any recovery for interest accruing on the bonds during the time for which they were paid in advance as money advanced to the contractor for the purchase of materials.—Oregon Engineering & Construction Co. v. City of West Linn, 185 P. 750.

RETAINED PERCENTAGE.

(Pa.) Where a contract of suretyship for performance of a municipal contract provided that on principal's default all moneys due him from city should become payable to surety, the principal, suing in assumpsit against city for balance alleged to be due, could not claim the retained percentage on ground that surety might never collect it—McKallip v. City of Altoona, 108 A. 408.

Where retained percentage on city construction contract was by terms of contract of suretyship assigned to surety, and it was bound to collect it, less any claim of city against it, its failure to collect it after proper notice would make it liable to an accounting for net balance due by the city and for any balance due on last estimate paid to surety.

REFEREE CANNOT OVERTHROW HIS OWN DIRECTIONS.

(Or.) In an action against a city to recover the price for constructing a reservoir and water system, in view of the contract, making the city's engineer the referee to determine the amount, quality, and fitness of work, and evidence showing that deviations from the contract by the contractor were at the instance of the engineer, *held,* that evidence supports court's finding for plaintiff contractor, despite deviations from the contract not authorized in writing by the engineer as required.—Oregon Engineering & Construction Co. v. City of West Linn, 185 P. 750.

ORAL EVIDENCE ACCEPTED.

(Mich.) Contract of plaintiff subcontractor *held* uncertain as to whether it covered certain excavating which contractor had agreed to do under his contract with city for installation of a water main, so that court properly received oral evidence tending to show intent of parties with reference thereto, and submitted to jury question whether work in dispute was intended to be included in plaintiff's contract.—People v. Boyes, 175 N. W. 289.

CAN ACT TO RECOVER CONDITIONALLY SOLD PROPERTY WITHOUT FILING CLAIM FOR PRICE.

(Wash.) Where the contractor with a city to equip a power plant conditionally purchased machinery and equipment which was installed in the plant, the seller of the equipment could maintain action against the city for recovery of the equipment and enforcement of its reserved rights without filing claim for the balance due on the purchase price in compliance with Rem. Code 1915, § 7998.—Allis-Chalmers Mfg. Co. v. City of Ellensburg, 185 P. 811.

The seller of machinery and power plant equipment to the contractor to install such equipment in a city's plant had the right to enter into a conditional sale contract retaining title to the equipment until the price was fully paid, and such contract was as valid and binding against the city, it having been actually given notice thereof before receiving any of the equipment, as if the city were a private individual, to whose contracts Rem. Code 1915, §§ 1159, 1160, had no application.—Id.

NEWS OF THE SOCIETIES

April 27-29—CHAMBER OF COMMERCE OF THE UNITED STATES. Eighth annual meeting, Atlantic City.

May 4-6.—NATIONAL FIRE PROTECTION ASSOCIATION; Chicago. Secretary, 87 Milk street, Boston.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 4-8.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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The American Concrete Pipe Association.

This association has recently been reorganized and will open an office in Chicago with sufficient help to carry on its broadened activities. J. W. Lowell, Eastern Manager of the Service Bureau of the Universal Portland Cement Co., beginning April 1, will assume the duties of assistant manager of the same department at its headquarters in Chicago.

The Material Handling Machinery Manufacturers Association.

At the directors meeting, April 6, The Material Handling Machinery Manufacturers Association of New York elected, president, Charles F. Lang (Pres. Lakewood Engineering Co., Cleveland).

BOARD OF GOVERNORS.

Vice President, Rumsey W. Scott (Otis Elevator Co., New York); treasurer, Lucian C. Brown (general sales agent, Elwell Parker Elec. Co., New York); secretary and manager, Zenas W. Carter (New York City, N. Y.); a board of governors and an executive committee.

The Association representation according to industries is as follows: Cranes, hoists and winches, Hall and Standart; gravity and power conveyors, Walter and Merrill; elevators, Scott and Jenkins; industrial trucks and tractors, Brown and Owens; bulk handling machinery, Stadelman and Robins; miscellaneous equipment, Helmstaedter and Miller.

Additional companies elected to active membership were: Whiting Foundry and Equipment Co., Harvey, Ill., E. H. Bourne; Motors Terminal Co., Cleveland, Ohio, B. F. Fitch; C. W. Hunt Co., Inc., West New Brighton, New York, S. S. Hathaway.

The information presented at this meeting indicates that every division of the material handling machinery field is being pressed for deliveries of machines and equipment.

American Association of Engineers.

Tentative program for fifth annual convention, Planters Hotel, St. Louis:

May 10, morning, routine business. Shall a Special Charge for Special Service be Made by the Employment Department?

Reports of Special Committees, Education, Ethics, Finance, Legislation, Membership, Salaries of Engineers in Public Service, Sub-Committee on Salaries of Engineers in Municipal Service, Committee on Salaries of Engineers in Teaching Service.

A Permanent Home for A. A. E.

Afternoon—Getting Pay Schedules into Budgets for the Public Service Engineer.

What Part Shall A. A. E. take in the Presidential Campaign?

Americanization and Man-Power Engineering.

Making the Chapter a Force in the Community; Getting all Engineers into A. A. E.; Publicity for the Chapter; Program; Miscellaneous Activities.

The Federal Department of A. A. E. at Washington.

Opportunities for the Engineer in Civil, Structural, Mechanical, Mining and Chemical Fields.

Coordinating A. A. E. Activities in the State.

Reorganization of A. A. E. on a Business Basis.

Evening — Group Meetings; Draftsmen, Federal, Highway, Industrial and Chemical, Mining, Municipal, Railroad.

Tuesday, May 11, Morning—Business.

Afternoon—Unity of the Engineering Profession in the United States; American Red Cross; Seeing St. Louis.

Evening—Annual dinner; A. A. E. Principles; The Year Ahead; Reading by the Authors of Original Poems Dedicated to A. A. E.

The American Association of Engineers has concurred with the other groups of subordinate officials established by the recent order of the Interstate Commerce Commission, and has nominated W. F. Milligan and W. J. Potts for members of the Railway Labor Board provided by the Transportation Act of 1920.

The University of South Dakota Chapter of the A. A. E. has elected the following officers: H. Edison Fowler, president; Julian Pederson, vice-president; Benjamin N. Bowers, secretary, and C. Harold Flocken, treasurer.

The Huntington (West Virginia) Chapter of A. A. E. has elected the following officers: L. T. Nuckolls, president; B. V. Davis, first vice-president; H. L. Vandament, secretary, and H. H. Gwathmey, treasurer.

The University of Missouri Chapter has elected J. W. Moody, president, and W. W. Gorth, secretary. J. W. Sylvester, Grover Godwin, W. M. Galligan and Professor Guy B. Newton are directors. Dean E. J. McCaustland is faculty representative.

The Spokane Chapter was organized on April 3. E. C. Scharf acted as chairman and V. W. Gamble as secretary.

The Denver Chapter was organized on April 6. A. Lincoln Fellows, senior irrigation engineer of the division of irrigation investigations, office of public roads, was elected temporary chairman and H. B. Hunt, engineer with the United States Reclamation Service, temporary secretary.

The association has granted chapter charters to members in St. Augustine, Fla., and a club charter to members petitioning from McGehee, Ark.

The A. A. E. has granted chapter charters at Gary, W. Va., Clifton-Morenci, Ariz.; Rochester, N. Y.; Huntington, W. Va. and the Missouri School of Mines. Club certificates have been conferred at Jefferson City, Mo.; Effingham, Ill., and Burrwood, La.

The membership of the A. A. E. at the close of business on March 31 was 15,104. Almost three times as many applications were received this March as in the corresponding month last year.

The Kansas State College Chapter elected the following officers for 1920; Walter E. Dickerson, president; C. H. Scholer, vice-president; H. Kenneth Shideler, recording secretary; M. W. Furr, corresponding secretary; and Paul G. Martin, treasurer.

Brooklyn Engineers' Club.

At the regular meeting April 15, a paper was presented by Milton H. Freeman, on "Stopping of Leaks in the B. R. T. Subway, at the B'way-Canal St. Station." The paper was illustrated by lantern slides and discussed the arrangement of station and general method of construction; source of leakage; plant for grouting; grouting stairways under Centre street; grouting between the lower structure and the I. R. T. Subway; (a) setting grout pipes; (b) regulation of mixture and grouting pressures; (c) condition of joint when grouting stops; (d) grouting seepage cracks; (e) regrouting; quantity of cement—time required to do the work; relation of grouting to the station waterproofing; effect of temperature changes upon grouted joints, and grout as a means of making overhead seal.

PERSONALS.

Brindle, T. S., has been appointed chief engineer, Ohio State Highway Department.

Breed, Eltinge H., recently first deputy highway commissioner of New York State, has been put in charge of highway engineering at the school of applied science, New York University.

Lenhart, L. G., has been appointed city engineer, Pontiac, Mich.

Grupe, George, has been appointed city manager of Brownsville, Texas.

McComb, D. Q., has been appointed division engineer, Tenn. Highway Department.

Ragland, Capt. R. F., has opened a general engineering and contracting office at Livingston, Montana.

McCourt, Prof. W. E., has been appointed dean of the school of the engineering and architecture of Washington University.

Elwell, A. T., has opened an office at 61 Broadway, New York, as consulting engineer on South American engineering projects.

Dawson, Shelton, has been appointed city engineer of Charles City, Ia.

Hurd, J. T., has been appointed city engineer, Eau Claire, Wis.

Jowers, G. M., has been appointed city engineer of Berde County, Texas.

Buck, R. J., has been appointed city engineer, Muskegon, Mich.

Bastable, F. J., assistant superintendent Department of Public Works, Rochester, N. Y., died February 19.

INDUSTRIAL NOTES.

Emanuel Slag Company.

H. C. Pastorius, for twenty years connected with the Central Railroad of New Jersey and having wide experience in the slag business, has accepted a position with the Emanuel Slag Company. He will handle the sales and traffic of this fast growing company. Their crushers are located at Catasauqua and Glendon, Pa., with their main office at 719 Hamilton street, Allenton, Pa.

Wallace & Tiernan Co., Inc.

Wallace & Tiernan Co., Inc., manufacturers of chlorine control apparatus for water and sewage purification and industrial uses, announce that Mr. Harold S. Hutton has been appointed district sales representative with headquarters in the Commonwealth Building, Pittsburgh, Pa. Mr. Hutton is a sanitary engineer who has previously been connected with the public health service and succeeds Mr. P. O. Collins, who is given indefinite leave of absence on account of illness.

Reliable Oxwelded Tank.

Out of the debris of a $400,000 fire that swept two blocks of Tampa's industrial district last December practically the only salvage was a 12,000-gallon oxwelded oil storage tank, which was afterwards found intact excepting for dents and scars that were later removed. Inspection showed that the oxwelded seams held tight at every point, no leak developing anywhere in the welds.

The tank contained 5,000 gallons of gasoline at the time of the fire. When the platform supporting it was consumed the tank fell to the ground smashing a 5-inch outlet pipe. Roofing, beams and framework fell in and burned on top of the tank. Also a brick wall of an adjacent building collapsed, hurling tons of the brick on the conical top of the tank and bending the cone head below the level of the top tank ring. The tank was located approximately in the center of the burned area.

This example of the strength and endurance of oxwelding is noteworthy because the unusual shocks and strains to which the tank was subjected and because the tank itself is typical of oxwelded structures of the kind. The specifications of the tank had a diameter 16 feet, depth 11 feet, including the 2½-foot cone head, and was made of 10, 12 and 14 guage iron.

The tank was built by the American Welding & Tank Company, of Tampa, Fla., and was constructed on the premises, where only a 2-foot clearance was allowed, making the work unusually difficult. The tank is in service today, as good as the day it was finished.

New York City Branch of the Four Wheel Drive Auto Company.

J. H. Thompson has been appointed manager of the recently established factory branch at New York City of the Four Wheel Drive Auto Company, Clintonville, Wis., makers of FWD trucks. The new branch covers a territory from Baltimore to New England.

Mr. Thompson started in the automobile game with the Babcock Electric Carriage Company at Buffalo, where he was for a number of years manager and territorial agent. He has later been connected with the sales organization of the General Motors Company and the Mercury Manufacturing Company.

Vacuum Steel Cleaners.

A patented vacuum street cleaner will soon be placed on the market by the reorganized C. B. Street Cleaner Company, Columbus, Ohio. The machine is designed to eliminate dust and to replace 5 teams of horses and their drivers, 4 men with push brooms and 4 men to shovel the dirt into wagons that are required by the ordinary hand process.

PROBLEMS CITIES ARE STUDYING WITH EXPERTS.

The public works commissioner of Detroit was appointed a commission to devise for the construction of the $7,000,000 SEWER SYSTEM a plan that will afford protection from the fluctuation of prices of labor and materials and encourage the contractors who refuse to bid on the work under present conditions and requirements.

According to J. R. Hendry, city sewer engineer, many of the contracts let a year ago at what was considered a fair price are now being carried out at a loss to the contractors, due to advances in labor and material costs.

The commission consists of W. S. Kinmear, consulting engineer, W. F. Hoad, University of Michigan engineering department, John Mercier and George Cook, contractors and members of the city engineering corps, are collecting data on material costs which will be used as the basis of their recommendations.

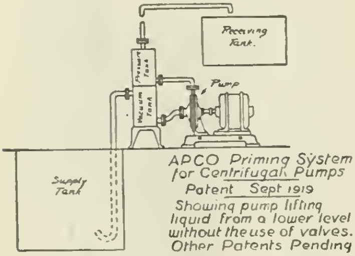
Erie, Pa., has plans for a $667,500 INTERCEPTING SEWER disposal system. Chester & Fleming, consulting engineers.

New Appliances

The Apco Primer.

The Apco Primer manufactured by the Automatic Primer Company is a useful adjunct for centrifugal pumps that is adapted to any condition where any kind of valveless pump is used and it is necessary to maintain a vacuum on a suction line. After once being primed, the pump is always ready to start without danger of failure to function.

This system requires the installation of two tanks, one placed above the other and each having a capacity approximately 1/3 greater than the volume of air or gas in the suction line when expanded to the vacuum of the operation. The lower tank or the lower division of a double tank is filled nearly full of liquid and the pump being started lowers the level of the liquid producing a partial vacuum and starting the liquid to flow through the suction line. While pumping, the upper tank or upper portion of double tank is always filled with liquid which, when pumping ceases, returns by gravity to the lower tank forcing the air back to the suction, flushing the suction line and repriming the system. The size and type of the Primer is governed by head against which the pump works, total length of suction line, diameter of suction line, and maximum vertical suction lift.



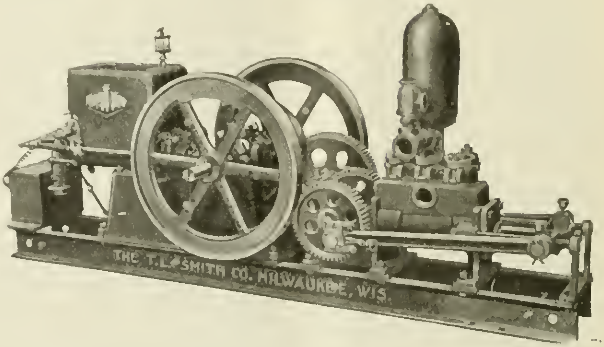
ARRANGEMENT OF PRIMER OPERATING WITH TWO TANKS.

Book for Pump Users.

Contractors and road builders will find the pamphlet, Never Failing Water, sent free by the T. L. Smith Company, interesting because it contains pump statistics on uses in connection with paving machinery. It shows by example how to figure the size of a pump necessary to supply a certain gallonage of water from any specified distance. It shows the friction loss developed by the passage of water through pipes of various sizes. It has a set of statistics showing the amount of friction contributed by pipe fittings such as elbows, bends, valves, etc. Handy charts show at a glance the quality of water contained in rectangular or circular tanks of various dimensions. In addition it gives some very valuable operating hints which will enable the user to get more efficiency out of his pumping outfit.

The book tells, too, about the complete line of Smith pumps, which includes force, diaphragm and centrifugal outfits of various sizes. The principle of extreme simplicity on which they are constructed gives fewer working parts, and the design of the pump is such that any part can be removed without dismantling other parts.

The Smith high pressure force pump is the only double acting force pump with a double train of gears which has the jack bearing cast integral with the pump to insure perfect and permanent alignment of the shafts and cross head pinions,



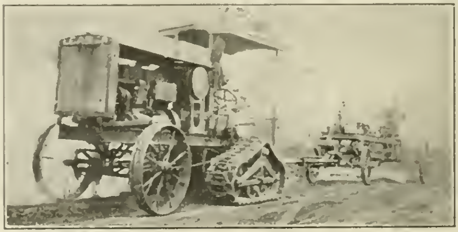
DOUBLE ACTING HIGH PRESSURE FORCE PUMP WITH DOUBLE TRAIN OF GEARS.

Leader Crawler Tractors.

These tractors are recommended by the Dayton-Down Company for road work on account of their great power, light weight, durability and flexibility. They are made in two sizes and burn from 18 to 30 gallons of kerosene oil daily. They are built with two light smooth face front wheels and are mounted in the rear on a four-wheel truck with caterpillar traction and Hyatt roller bearings. They have a forward and reverse speed of 2 miles and a high speed of 3¼ miles per hour; transmission is of the automobile selective type with sliding gear. All gears are of cut steel and the heavy channel bar frame is heavily braced and trussed. Both sizes have a 98-inch wheel base and a shipping weight of 6,200 pounds or 6,500 pounds.

Smith Simplex Paving Mixers.

The T. L. Smith company has issued a new booklet describing the paving mixer that has been designed to solve just these problems. The Smith Simplex frame is twelve times as strong as the ordinary single channel frame.



CRAWLER TRACTOR HAULING ROAD MACHINE.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, MAY 1, 1920 No. 16

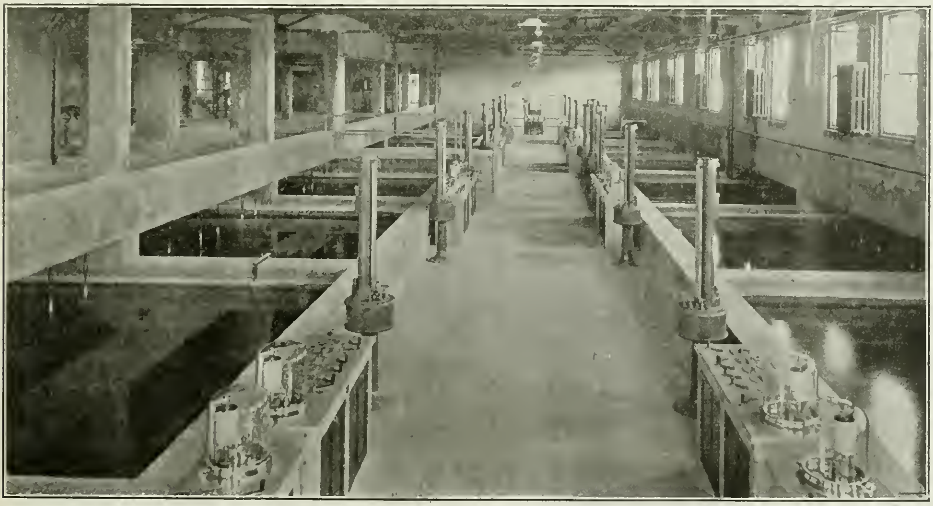
Water Purification in Flint, Mich.

The old filtration plant was doubled in capacity to provide for a similar increase in population since 1910; dry feed of chemicals was substituted for solution feed; softening was provided for, and other extensions and improvements made. At the same time the old pumps were replaced by larger and more efficient ones.

Last year, the municipal water works of Flint, Mich., began the use of a greatly enlarged purification plant and one believed to be up-to-date in every respect. At the same time it had greatly increased its pumping plant and made other improvements as part of a program begun in 1910 with the report of a joint committee on water supply. The service became municipal in 1903, when the plant of a private company was purchased by the city.

The city has a population of about 50,000, having increased about sixty per cent. since 1910, when the population was about 38,500, while in 1900 the population was only about 13,000. The supply is taken from the Flint river at a pumping station about a mile above the center of the city. The drainage area above the city is approximately 1,500 square miles.

In 1910 most of the pumping was done with a Laidlaw-Dunn-Gordon pump of 7 million gallons capacity, with a 4 million Holly and 1½ million Holly-Gaskill in reserve. In 1912 the Board of Water Commissioners built a new pumping station and filtration plant after plans developed by W. G. Clark of Toledo, Ohio. The pumping plant installed in the new station comprised a new Snow 12,000,000-gallon crank and fly-wheel pumping



MAIN OPERATING FLOOR OF FLINT FILTRATION PLANT.
Shows loss-of-head gauges, operating tables, controlers, etc. Looking north into pump room.

VIEW IN CHEMICAL LABORATORY.

engine, and the old Laidlaw-Dunn-Gordon 7,000,000-gallon and Holly 4,000,000 were continued in service. There were also installed three 6,000,000-gallon DeLaval turbine-driven, geared, low-head pumps. The filtration plant was a rapid sand filter of 10,000,000 gallon capacity installed by the Pittsburgh Filter Manufacturing Company in accordance with the general practice and usage of that time, the chemical agents being dissolved and mixed in large tanks and added to the water through orifice boxes in the usual way. At the same time the distribution system was greatly strengthened and extended.

In 1916 it was decided to double the capacity of the filtration plant and add to it an equipment for softening the water. The capacity to be provided for ultimately was decided upon as 36,000,000 gallons per day, although the present capacity is only 16,000,000 gallons, which, however, is nearly double the capacity of the plant built in 1912. Although the contract was entered into in 1916, owing to delay in the excavation (which was under a separate contract) the actual work was not started until late in the summer of 1917. Difficulties of labor and of other kinds delayed the completion until the spring of 1919, and incidentally greatly increased the cost.

At the same time arrangements were made for increasing the pumping equipment. A 15,000,000-gallon high-lift pump was installed and has just been placed in service, and the old 7,000,000-gallon pump will soon be replaced with another 15,000,000 gallon unit. There is contemplated a 20,000,000-gallon high-lift turbine centrifugal and a 30,000,00 gallon low-lift centrifugal.

CONSTRUCTING NEW FILTRATION PLANT.

There were a number of very difficult engineering problems to be worked out in making the addition to the purification plant without interfering with the operation of the old plant in furnishing filtered water to the consumers. The new construction consisted of building two new settling basins of approximately 2¼ million gallons capacity, a baffled mixing chamber, eight additional filter units of one million gallons each, a new head house and chemical storage building, new laboratory, chemical feeding devices, intake and suction well. The entire cost of the work was in the neighborhood of $350,000.

While constructing the new plant, it was necessary to operate for a considerable period with only one basin, owing to the fact that columns supporting the building and storage bins were constructed in the second basin, and in the end of this basin was constructed a portion of the conduit carrying water from the inlet well to the new mixing chamber. When the new chemical equipment, settling basins and clear-water well had been practically completed, the old mixing chamber was put out of commission and reconstructed to form the completed conduit to the new mixing chamber.

The supply conduit between the new and the old filters was then connected. This necessitated closing down the plant for a few hours to permit of building bulkheads, so that this work could be done and time provided for the setting of the concrete in the work. After the concrete had set, another short intermission of operation was required for the removal of the bulkheads, after which the water was turned into the new mixing chamber, basins and filters.

In order to connect the new clear water basin to the old ones, a float was built in the old clear-water well and a tight bulkhead provided with packing and a pipe connection to the inside. This bulkhead was sunk against the wall of the basin at the point of opening and the water withdrawn from the space between it and the wall. The pressure of the water in the basin kept it in place and the opening was cut through the wall from the opposite side, after which the bulkhead was removed and the connection completed without interference.

SUCTION PIPE AND WELL.

The original plant had been connected to the river with a 3½-foot brick conduit about 500 feet long connected directly to the suction of the low-lift pumps. This conduit had been slowly filling

MIXING CHAMBER AND BAFFLING SECTION.

SECOND FLOOR OF HEAD HOUSE.
Showing bottoms of chemical storage bins. Daily hoppers are directly underneath.

FRONT VIEW OF PUMPING STATION AND FILTER PLANT.
Raised portion of ground covers sedimentation basin.

with sand, and to provide for cleaning it, it was decided to install a second intake and connect both to a concrete suction well immediately adjoining the pumping station. The second conduit is 48 inches in diameter, circular section, of reinforced concrete. The suction well is rectangular, about 10 feet by 40 feet, and extends about 4 feet below the outside wall of the station, which necessitated a new foundation wall for the station, which wall was built in sections. The suction well is divided into two sections and so arranged that either conduit may be thrown out of commission.

The well was built around the old conduit, and after its completion the section containing this conduit was cut off from the other. That part of the conduit passing through the well was then removed and a sluice gate fitted to the end where it entered the well.

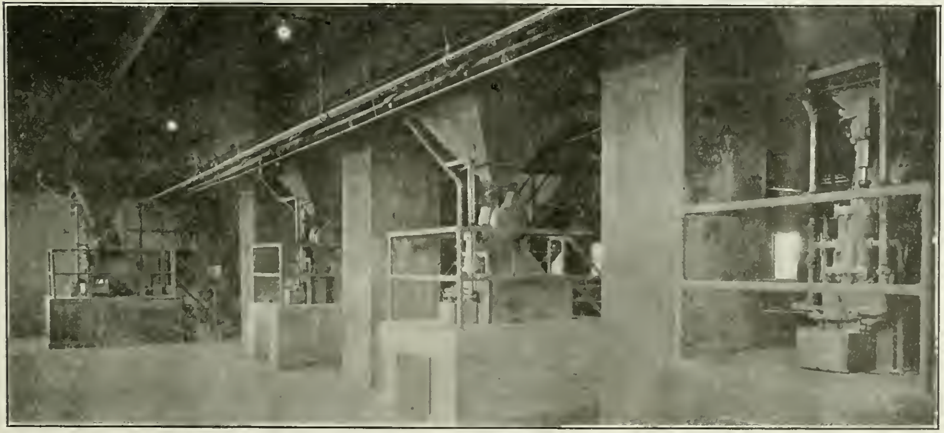
The contract for the entire work, as well as for the equipment, was given to the Pittsburgh Filter and Engineering Company and the work was done under the general supervision of F. N. Baldwin, the superintendent and manager of the Flint Water Department.

THE PURIFICATION PLANT.

In designing the new plant, an effort was made to install all of the approved modern features of such plants, among these the dry feed of chemicals. It is believed that this plant is the first to be designed and completed for the use of dry chemicals, although twenty-five or thirty other plants are now using dry chemical feed, but as this was provided for by means of changes in the original plans they are not arranged for the best economy.

For storing the chemicals there are eight reinforced concrete hopper-bottom bins which provide storage for approximately 600 tons. The materials are unloaded from the cars directly into storage battery trucks which operate over a concrete runway to hydraulic elevator cars, which raise the trucks to the charging floor, where the material is discharged directly into the storage bins. All the bins are connected directly to daily hoppers which are provided with chutes and slide gates. The bottom of each of these daily hoppers is connected to a dry feeding machine, of which there are three for handling hydrated lime (which is stored in six of the bins) and two for pulverized alum or iron sulphate receive a discharge from the other two bins.

The feeding machines will discharge any amount for which they are set between 100 pounds and 10,000 pounds a day and are operated automatically



MAIN FLOOR OF HEAD HOUSE, SHOWING DRY-FEED MACHINES.

in proportion to the amount of water entering the plant. The machines are dust proof and are provided with glass windows for observation. F. N. Baldwin, superintendent of the water works, to whom we are indebted for this information, informs us that "The general appearance of the machine is very neat, and it is giving excellent satisfaction and, from our point of view, there can be no comparison between the dry feed mechanism and the old method of solution feed; in fact, the dry feed mechanism has practically eliminated guess work from the amount of coagulant as added to the water.

"The operation has proved very satisfactory, both as to enabling us to get practically a complete removal of color, which we were unable to do with the old plant arrangement, and also enabling us to reduce the hardness from 230 p. p. m. to 110 p. p. m. It is possible to bring the water down to a neutral point, but only at a great expense, which we do not feel would be warranted, hydrated lime being used entirely for the softening purposes."

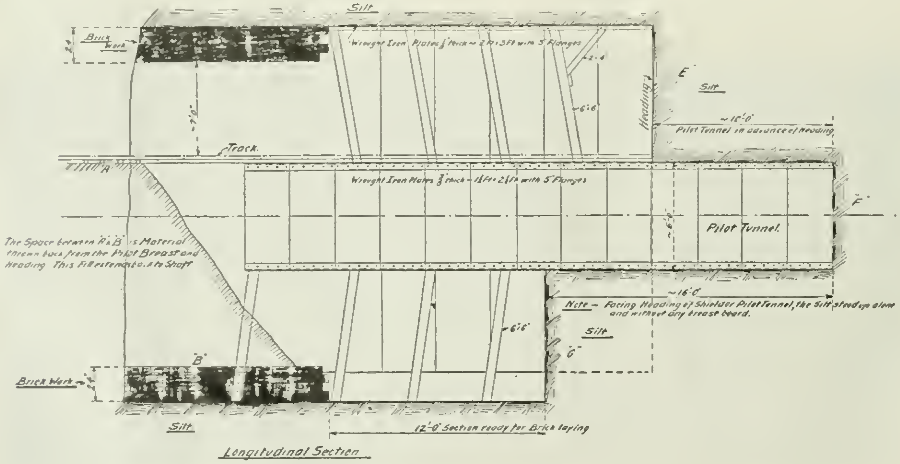
The water is brought to the filters through a concrete conduit and passes in the usual manner through sand beds and a manifold system in the filters to the clear well. All filters are controlled by hydraulic valves and equipped with automatic controllers of the Earl type, controlled by a master controller which is operated from the clear well, the level of the water in which is thus maintained at a pre-determined level.

The floor of the operating gallery, as well as the entire first floor and laboratory, are covered with mosaic tile and the entire interior of the building is painted with cream white enamel, giving a clean and sanitary appearance.

Tunneling in Silt

Thickness and tenacity of silt in the bed of the Hudson river demonstrated by its behavior and properties disclosed in excavating by tunnel methods. Notable absence of supposed unstable character disclosed when penetrated at a depth of only a few feet below the river bed. A plastic, tenacious mass of dense, thick material forced into the Pennsylvania Railroad tunnel in a continuous body that could be cut with a knife. Similar material in Hudson tube tunnel formed embankment with steep face, carrying constant traffic satisfactorily. Authoritative data of great importance to subaqueous excavation here published for the first time.

The Pennsylvania Railroad Company's single-track tunnels under the Hudson river, New York, were driven by the shield method through the silt at as high an elevation and as near the river bottom as was thought prudent. As the bottom here is of a sedimentary character with soft mud on top and is made of fine materials through which piles can be driven to a great depth, considerable anxiety as to its reliability and sustaining power was felt before the tunnels were built. It was even asserted that it would not afford stable support for the tunnels, that it had not sufficient strength


Silt
Brick Work
Wrought Iron Plates ⅝ thick ~ 2 ft x 3 ft with 5" Flanges
~2'4"
~7'0"
~6'6"
Heading
E
Silt
~10'0"
Pilot Tunnel in advance of Heading
Track
A
Wrought Iron Plates ⅝ thick ~ 1½ ft x 2½ ft with 5" Flanges
F
~6'0"
Pilot Tunnel
The Space between A & B is Material thrown back from the Pilot Breast and Heading. This Fill extends to A to Shaft
~16'0"
Note – Facing Heading of Shield or Pilot Tunnel, the Silt stood up alone and without any breast board.
~6'6"
Silt
G
B
Brick Work
Silt
12'0" Section ready for Brick laying
Longitudinal Section

EXCAVATING OLD HUDSON TUNNEL IN HARD SILT WITH SECTIONAL PILOT TUBE AND TOP AND BOTTOM SEMICIRCULAR HEADINGS.

to protect them during construction, to prevent their settlement afterwards, or to retain the compressed air used to balance the external pressure. Provisions therefore were made for openings in the lining of the tunnel invert to permit the sinking of foundation piles after the tunnel was in position, an operation that was eventually wholly discarded.

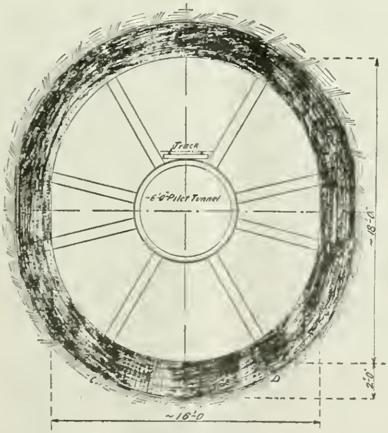
CHARACTER OF SILT

The tunnels were very successfully driven with shields and pneumatic pressure and the character of the soil encountered was not found to be especially difficult, even at points of maximum difficulty where the alignment passed from earth to rock. In general, the soil was firm and tough, apparently identical with the clay deposits on shore in the Hudson river valley and with the strata encountered in sinking the deep dredged foundations of the Poughkeepsie bridge and in deep clay pits excavated in cofferdams at Haverstraw.

At the tunnel elevation, a minimum of about 20 feet below the river bed, there was no indication of soft mud or soupy or flowing material, nor was there any action resembling quicksand or slumpy earth. The stiff, solid mud or clay encountered was dense enough to retain the air pressure well and stood up satisfactorily where exposed. The heavy pressure exerted by the powerful hydraulic jacks in the shields tended to squeeze moisture out of it, which, together with the waste of the water used in the jacks, produced a film of water around the shields tending to soften the surface of the clay in contact with it, but when exposed to the compressed air it soon dried.

DISPLACEMENT OF SILT BY SHIELD

Although it was a fine, dense clay, which could be penetrated by pressure, it was stiff and tough, and when the shield 23½ feet in diameter was forced ahead by an aggregate pressure of about 3,000 tons furnished by twenty hydraulic jacks, the soil was displaced upwards, permitting the shield to advance. The forward end of the shield could be entirely closed by heavy transverse vertical bulkheads in which doors could be opened at pleasure. No excavation was required in advance of the bulkhead and when the shield was "shoved," a 3x3-foot door in the bulkhead was opened, permitting a portion of the clay to enter and relieve the pressure in front. For each shove, the shield advanced 30 inches, at an average speed of about 1¼ inch per minute, while the material entered through the open door in a solid, continuous, compact mass at the rate of about 12 inches per minute, or about 10 times as fast as the shield advanced, a single continuous plug or sausage 20 or 25 feet long being forced into the tunnel with each shove, and thus offsetting perhaps a third of the volume displaced by the movement of the shield. After entering the shield, the sausage retained the marks made by forcing it through the door as through a die and presented sharp corners at the top and bottom of the vertical sides. It formed one smooth, unbroken mass until the rear end was forced off from the supporting platform and broke off or was cut, while the front end entering through the bulkhead was bent sharply downwards and showed distinct laminations, as are evident in the photograph shown on the front cover of this issue.


Track
-6'0" Pilot Tunnel
~18'-0"
2'-0"
C
D
~16'-0
Cross Section.
Note:- There is no Plate between C & D, and Brick was layed on exposed Silt

MOVABLE PILOT TUBE BRACED TO PERMANENT BRICK LINING.
Muck track above pilot tube.

CLAY BLANKET

It is the opinion of Major John F. O'Rouke, president and chief engineer of the O'Rouke Engineering Construction Company, contractor for this work, that this material prevails throughout the lower portion of the channel of the Hudson river and with proper treatment can be easily and safely tunneled through wherever a sufficient body of it exists above the tunnel roof, and that, where this is not the case, conditions can easily be made safe and satisfactory by simply increasing the thickness by the deposition of clay dumped in the river bed above to the required depth, displacing sideways the 50 feet of material, as was very successfully done in the construction of the six subway tunnels for the Public Service Commission across the East river, New York.

HUDSON TUBES TUNNELS

The tunnels under the Hudson river to Manhattan Island which now form a portion of the uptown line of the Hudson Tubes (sometimes called the McAdoo Tunnels) were commenced more than 30 years ago, when the use of compressed air for tunneling methods was comparatively novel and there were few engineers experienced in this class of construction. Great difficulty was experienced at first in building these tunnels under air pressure with open excavation closely followed up with a brick lining, which method left large, unprotected headings or faces, and resulted in serious blowouts and eventually caused a disastrous run-in near the shaft connection which cost many lives. Afterwards the tunnel was extended about 2,000 feet by the pilot method under the direction of Col. Haskin and finally was completed by the modern pneumatic shield method similar to that used for the construction of the Pennsylvania Railroad Company's tunnels a few miles farther up the river. The brick chamber for these shields was 23 feet in diameter.

PILOT METHOD OF DRIVING

The pilot method involved the use of a long sectional steel tube 6 feet in diameter driven in advance on the center line of the tunnel. This tube was made in rings 30 inches long, each composed of bent plates bolted together through inside flanges provided on all of their edges. The tube afforded preliminary protection and was subsequently used to shore the ⅛-inch segmental plates set against the clay in the roof and sides and thus prevent caving in of the full size tunnel excavation before the completion of its brick lining.

In driving the pilot tube, the miners excavated the earth face, making room for the addition of another ring, the segments for which were removed from the rear of the pilot tube and bolted on in front as the work progressed. The rear end of the pilot tube was always thoroughly braced by radial struts engaging the permanent tunnel lining and the outer ends of these strets were inclined backwards to give support and resist any possibile backward thrust in the tube.

The forward end of the pilot tube was always solidly embedded in the soil while excavation was made around the middle portion of the tube and carried out to the circumference of the finished tunnel, where the earth was retained by the lining of segmental steel plates similar to but lighter than those used for the pilot tube, which were intended to support the clay until the permanent brick lining 2 feet thick had been completed in the rear in lengths of 12 to 15 feet. The pilot tube was of such length that it always extended into the completed brick lining and was braced against it and directly against the permanent steel lining plates against which the brick work was laid.

The cross-section of the tunnel was not quite circular, the vertical diameter being 22 feet long and the horizontal one 20 feet long from out to out of brick work.

ENLARGING EXCAVATION IN DRY SILT

The tunnel was enlarged and the brick lining was laid in sections 12 feet long, in which operation the excavation around the pilot tube was made in top and bottom headings where the silt stood up as it did in front of the pilot tube without breast boards. Sometimes, however, a tendency to scale off caused the use of an occasional breast board in the bottom and top headings.

In starting a new ring at the top of the full size excavation, the silt at the top of the headings was excavated 2 feet forward of the last ring about 3 feet long and the top plates were put in place simultaneously with the erection of the side plates in the rear. The plates were flange-bolted together and were braced to the pilot tube, but they were not continued around the full circumference of the circle, the lower plates resting with their edges supported only on the earth. The invert of the full size tunnel excavation was thus left exposed without developing any tendency to rise or flow and was found stiff enough to support the workmen and receive the first course of brick lining.

The silt or clay encountered in the excavation was quite hard and was removed in solid lumps cut out with a square pointed shovel similar to a garden spade, but wider and sharper. The 12-foot section of tunnel was widened out to full diameter around the pilot tube by 25 men working 36 hours and the brick lining was laid up by six men in 24 hours, the finished tunnel being completed at the rate of about 5 linear feet per day.

The muck excavated from the faces in the headings E, F and G was stored on the finished brick invert, where it was piled up to a height of 14 feet and was stable at a steep slope at the forward end. The muck was so stiff and dry that the service tracks were laid directly on top of it and the men and mules traveled back and forth over it without difficulty.

OFFICIAL'S STATEMENT

P. Fitzgerald, assistant superintendent of the work, who made the sketches from which the accompanying diagram was prepared, states that, "About the year 1889 Pearson & Son took charge of the tunnel work. We excavated a large chamber at the advance heading in which we assembled a shield, which came from England. From that place on, cast iron plates were used. When the shields were ready to push forward, we found we had not sufficient power to do so and it was necessary to put men in the shield pockets to clean them out. About 1902, Mr. McAdoo took charge and operations continued until we struck rock, when it was found necessary to alter the front of the shield and we excavated a chamber extending 6 feet forward of the cutting edge. In making this excavation, I found the silt as hard as it was 2,500 feet further back, where the shield was first installed.

"In the excavation mentioned before and while the tunnel has been driven by the pilot method, there was no water in evidence as coming through the silt. Occasionally we had some bad rushes of water between tail end of shield and tunnel lining. This was remedied by dumping mud in the river over the shield."

SILT EXCAVATED WITH VERTICAL FACES OUTSIDE OF SHIELD

Referring to the Pennsylvania Railroad Company's tunnel from 34th Street (Manhattan) to Weehawken, on the construction of which he was employed, Mr. Fitzgerald said: "When the four shields driving the Pennsylvania Railroad tunnel arrived at the bulkhead line in both sides of the river, it was necessary to go in the front of the shield and cut off the bulkhead piles. In the Weehawken side, we excavated the breast from the top of shield to the bottom. The silt was about as stiff as in the McAdoo tunnel and stood up allright. We shoved the sliding platform against the breast as a precautionary measure. In the New York side. at the bulkhead, we found course rubble which extended some distance down from top of shield and under this was the silt the same as in Weehawken. The rubble was braced but the silt did not require such attention. After pulling the test piles which were screwed down through the bottom of the tunnel about the center point, we filled in the holes and closed the bottom plate. The clay was hard and there was no water in the cavaties exposed before filling them."

Hudson River Silt

In view of the difference of the opinions on the subject of the preceding article which are held by two men prominent in tunneling work, John F. O'Rourke, a tunnel contractor of wide experience, and Clifford M. Holland, chief engineer of the New York State and New Jersey Interstate Tunnel Commissions, we submitted to each of these a copy of the preceding article and the editorial on the subject which appears in this issue, and have received from them the following letters:

Editor Public Works; Dear Sir,

Referring to "Subaqueous Excavation for the Hudson River Tunnels," the objection raised therein to the difficulty of maintaining proper pressure in a shield of very large diameter does not apply to Hudson river silt but to sand and gravel which would be encountered in the approach section. In other words, the Hudson river silt is the one material in which differential air pressure gives no concern.

In the last paragraph of this article, you draw a conclusion which is in my opinion absolutely unwarranted in referring to the clay in Boston Harbor as being of a somewhat similar nature. They are not of a comparable nature for the Boston blue clay is a very stiff material, as stated, whereas the Hudson river silt is stiff only under the action of air pressure. In this connection you should bear in mind that Mr. Fitzgerald's statements are made in regard to a material which he has observed under compressed air conditions which those familiar with the effect of compressed air upon material of this character appreciate transforms its character, as the introduction of air drives the water out of the mass and eliminates the lubricant which causes it to flow.

In regard to the article "Tunneling in Silt," there is one point which should be clearly brought out, and that is that the Hudson river silt does materially differ from any other material in that it is possible to push the material aside without excavating. You can not possibly do this in a stiff blue clay such as is found in Boston nor can you do it in the quicksand in the East river.

In regard to the controversy as to the real character of the Hudson river silt, the statement of Mr. O'Rourke proves conclusively the very point which we contend, as follows:

Mr. O'Rourke states that the Hudson river silt under compressed air stands up very firm—so firm that you can cut the faces into successive steps. I believe that this statement is based on Mr. Fitzgerald's statements referring particularly to the work in the old Haskin tunnel. Mr. O'Rourke has further stated, with photographs as supporting data, that at the time of shoving the shield, the material comes in ten times as fast as the shield advances, which shows the abnormal stresses set up in the Hudson river silt by the pushing of the shield, excavating only part of the face.

Furthermore, this same condition is shown by the fact that if the shield is shoved, it is necessary to keep the hydraulic pressure on the jacks; otherwise, the material pushes the shield back to where it started. These statements prove conclusively that the material around the shield is under abnormal stress and upon the immediate passing of the shield, grips the tunnel, causing the shortening of the horizontal diameter, a phenomenon which has been observed throughout the construction of tunnels in this material.

With such positive evidence of stresses in the material, what good would it do to wrap a layer of gravel around the ring, even if there were a possibility of ejecting it? This is the key note to the whole question. It is not one as to the fluidity of the material but rather as to the stresses actually set up in the material during tunneling operations. The question of fluidity does not enter into the discussion except that it has been taken up as a secondary consideration to illustrate the greater active pressures existing in a material with a low angle of repose which was determined by General Raymond to be 2° 46′ from exhaustive tests made during the driving of the Pennsylvania tunnels.

There is an error in the statement that the doposition of clay would be dumped in the river bed, as was the case in the 14th Street tunnels. * * * A general rule as to the depth of cover over the top of the shield in driving has been to have the depth of cover one and one-half times the diameter of the shield when the air pressures are balanced at the bottom so that, in order to drive the 42-ft. shield 50 ft. below the surface of the Hudson river, it would require a blanket which, theoretically, would have to extend about 12 ft. above the surface of the water so that, when you get into a discussion of the possibility of dumping clay in order to safe-guard the tunnel heading, you are getting into a realm of conjecture which leads into a discussion with no results. In other words, the proposed diameter of the tunnel so far exceeds practice that you can only draw upon your imagination for what would be needed. * * *

C. M. HOLLAND.

Chief Engineer New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission.

Editor, Public Works, Sir:—Referring to your articles on Tunneling in Silt and the editorial on Subaqueous Excavation for Hudson River Tunnels, I wish to make the following statement:

The facts that you have to keep in mind are that the original riverbed of the Hudson, where undisturbed, is a dry, firm, tenacious clay. That wherever the top of this original riverbed is at a depth too low to properly cover a tunnel, that heavy clay blankets deposited a sufficient time in advance over such soft places will displace the soft material and give the same kind of clay to a safe distance over the tunnel. So that it is simply a question of properly blanketing the tunnel line to enable a shield tunnel to be driven with great facility and safety, as has been done in the case of all the East River tunnels that were recently constructed.

It was in connection with driving these last tunnels that the method of clay blanketing the tunnel long in advance of the work underneath was first done. Before that, the clay blankets were usually dumped after their necessity was discovered in the tunneling operations. So that there is no longer any reason to tear soft ground along the tunnel line since its presence can be detected and soft ground displaced with heavy blankets long before the shield reaches the parts of the tunnel line so treated.

The great feature of the Haskin tunnel work was the fact of never encountering any water in the clay and that it stood up with very light plates sheathing the excavation for the top and sides, while the bottom was sufficiently hard to hold and have the brick work laid direct upon the clay.

I am using the word clay advisedly. While all clay is silt, the term silt has been used in connection with the material in a viscous state. There is nothing whatever viscous about the Hudson clay, except where the riverbed has been disturbed, and by adhering to the use of the word clay for this undisturbed ground the misunderstandings that arise are avoided.

The idea of not being able to use gravel in this clay is simply an opinion which has nothing to sustain it. The gravel can be used and the tunnels held as erected by its use, the same as would be the case in sand which is much more likely to shift before the gravel is blown into place than the clay is. It is my positive opinion that there is no reason whatever to fear that the clay will close in on the tunnel before the gravel can be blown. As a matter of fact it took more than a year to have this happen in connection with the Pennsylvania tunnels.

Very truly yours,
JOHN F. O'ROURKE.

Sanitary Engineer and Bacteriologist Wanted

The chief engineer of the New York State Department of Health, Theodore Horton, asks us to give publicity to the fact that the department wants an assistant sanitary engineer in the Sanitary Engineering Division, at a salary of $2,600 to $3,000 per annum. The State Civil Service Commission will hold an examination for the position on May 15. It is open to both residents and non-residents of the state.

Candidates must be graduates in courses of civil or sanitary engineering of a college or technical school of recognized standing and must have had in addition since graduation at least five years of satisfactory experience in sanitary engineering of which one year must have been in the construction of water supply or sewerage works. The position requires a knowledge of the design, construction and supervision of systems of sewerage and sewage disposal, and of systems of water supply and water purification; the principles of chemistry and bacteriology as applied to the sanitary quality of public water supplies and the principles governing stream pollution and its prevention; the principles of design and testing of plumbing and of the methods of refuse disposal. Subjects of examination: Written examination, relative weight 6; experience, education and personal qualifications, relative weight 4.

At the same time there will be an examination for assistant bacteriologist for the department, salary $2,000 to $2,500; age limits 25 to 45 years; open to residents and non-residents, citizens and non-citizens. Also for a sanitary supervisor at $3,500, a senior statistician, at $1,500, and an epidemiologist at $3,500 to $4,000.

Municipal Safety

The National Safety Council, Chicago, has just issued a bulletin giving a summary of accident records of 14 cities in the United States for the year 1919. In New York there was a total of 4,173 killed, including 1,128 in highway accidents, 976 by falls and 188 by miscellaneous accidents; in Chicago 420 automobile and 235 industrial accidents; in Cleveland, 136 automobile and 254 industrial; in St. Louis, 97 automobile and 42 industrial, in Baltimore, 584 total accidents; in Rochester, 23 automobile, 15 industrial, 105 total; California, 67 automobile, 307 total; Omaha, 24 automobile, 11 industrial; Bridgeport, 36 automobile, 9 industrial, 100 total; New Orleans, 29 automobile, 28 industrial; Milwaukee, 81 automobile, 318 total; Spokane, 6 automobile, 35 total; Springfield, Ill., 12 automobile, 49 industrial, 159 total; Evansville, Ind., 8 automobile, 9 industrial.

Dr. R. S. Vitt, coroner of St. Louis, reports that in 1919, with a population of 922,000, St. Louis had fewer coroner's inquests than in 1901 when its population was only 604,000 and that industrial fatalities were reduced from 110 in 1917 to 42 in 1919. A comparative chart of coroners inquests reveals the fact that inquests in St. Louis jumped from 1,200 in 1905 to 2,000 in 1917 and that in the next two years they dropped to 1,400 as a direct result, the coroner says, of the safety campaign inaugurated at St. Louis during the 1918 Safety Congress and continued since then by the St. Louis local of the National Safety Council.

St. Louis, therefore, lays the formal claim to the title of the safest city in America and ten other cities, while not definitely questioning her right to it, are endeavoring to beat the St. Louis record. These cities are Cleveland, Cincinnati, Pittsburgh, Kansas City, Wilmington, Del., New York, Minneapolis, Buffalo, Portland, Ore., and Rochester, in each of which the local council of the National Safety Council is now conducing a permanent public and industrial safety campaign. In a score of other cities, principally Detroit, Boston, Grand Rapids, Mich., Harrisburgh, Pa., Milwaukee, St. Louis, St. Paul, Duluth, Toledo and Syracuse, N. Y., definite plans are under way for the establishment of similar local safety councils with a full time paid secretary.

An Engineer Decorated

The French order of the "Merite Agricole" has just been bestowed on Major E. A. Kingsley, recently casual officer in the S. O. S. and superintendent of roads from the Mediterranean Coast north to Paris and from the advance section west to the base ports. Major Kingsley was for seven years chief engineer of Little Rock, for two years engineer for Pulaski County and later first state highway engineer of Arkansas.

Municipal Asphalt Paving Plants

Since publishing the list of municipal asphalt paving plants in our issue of April 17, we have received from Mr. Mullen the name of Guayaquil, Ecuador, and also the plant in the Bureau of the Bronx, New York City, which was unintentionally omitted from the list.

PUBLIC WORKS.

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Should Engineers Prepare Contracts?

It has for years been the practice for engineers, both regularly employed officials and consulting engineers, to prepare the specifications for work upon which bids are to be invited and to attach to these a form of contract to be signed by the successful bidder. This form is generally copied from others which presumably, having served for numerous former contracts, is legally correct. The question was raised recently whether it is compulsory that every contract be drawn up by a lawyer, and was decided in the negative, as told elsewhere in this issue.

But while an engineer *may* prepare the form of contract, it would seem to us advisable that both this and the specifications be passed upon by a local lawyer. In the case of a city, this should be the city's counsel; while most companies retain a lawyer for such purposes. This submission to a lawyer is no reflection upon the engineer, who is not supposed to be a legal expert; and the safeguarding of the interests of his client involves the assurance that the form in question meets all requirements of local laws and ordinances. To mention only one point, the several states have different laws relative to mechanics' liens, and the same contract might not be consistent with all of them.

Subaqueous Excavation for Hudson River Tunnels

Before the pneumatic shield method of driving subaqueous tunnels had reached its present perfection, the driving of tunnels, especially those of large diameter, through mud and silt a short distance below the river bottom was considered very difficult and hazardous and on one occasion great loss of life occurred in the first attempts to tunnel the Hudson river from the lower part of New York City to New Jersey.

This work was done by The Hudson Tunnel Railway Company, organized by the promoter of the enterprise, Col. D. C. Haskin, who held a patent for tunneling under compressed air, and who at first assumed that practically no other support to the excavation would be required than that afforded by the air pressure. The method of tunneling, using light steel segmental roof plates, reinforced on all four sides by light angles, through which they were bolted together, was finally evolved, and this method is successfully used today in driving subaqueous and other tunnels of diameters up to twelve or fourteen feet. Notable examples of this, in this locality, are to be found in the work of the Passaic Valley Sewer Commission, including the big outlet sewer under New York Bay, now under construction.

This original Hudson tunnel was finally completed by the shield method, substituting cast iron in place of the brickwork previously used, under the recommendations of Sir Benjamin Baker, who advised the English investors in this financially defunct enterprise.

A little farther upstream, tunnels were driven by the same shield method for the Pennsylvania Railroad Company, all of them encountering substantially the same soil conditions.

At first, much was said regarding the dangers and unstable character of the soil penetrated, which has often been represented as semi-fluid and treacherous, very dangerous to encounter and so weak and unreliable that it would be unable to properly support tunnels even though they were driven through it. Such statements have direct bearing on the vehicular tunnel from New York to New Jersey which will soon be commenced. Some engineers claim that the conditions are such as to make it almost impossible to construct it safely and successfully, especially if the diameter is the maximum that has been proposed, much exceeding any precedent under similar conditions. Other engineers believe that the execution of the work with improved methods now available will not be unusually difficult, and that a reliable structure can be built safely with rapidity and economy.

One of the chief objections to the largest diameter proposed is the assumed difficulty of maintaining the face of the excavation and of preserving the required air pressure, which it is asserted cannot be easily differentiated at different elevations and if high enough to be adequate at the invert of the tunnel will be too high at the crown, causing blow outs there. These objections are especially directed to the approaches to the subaqueous tunnel, which it is expected will pass through sand and gravel.

The validity of these objections depends largely on the accuracy of the premises on which they are founded, so that any reliable information concerning the character and behavior of the soil to be encountered is of great value.

During the construction of the McAdoo and Pennsylvania Railroad tunnels, few visitors were admitted to the shields and little information was permitted to be given out concerning the details of the work and the conditions encountered. We are therefore fortunate in being able to present on page 369 of this issue reliable, specific information on the important characteristics of the silt and its treatment and behavior under practical conditions, prepared from the authoritative statements of one of the responsible experienced men employed on the work. These data, although now several years old, have never before been published and throw important light on the subject.

From them it appears that, so far as noted, the same conditions and characteristics prevail all along the bottom of the Hudson river in the vicinity of the proposed vehicular tunnel, and that the silt, at a reasonable depth below the bottom of the river, is a uniform, homogeneous, dense mass, tough and firm, which can readily and safely be excavated and which has sufficient strength to stand up well without support in vertical and steeply inclined faces. It also has tightness and strength to retain air pressure and, with proper treatment and appliances, can be tunneled more easily and safely than some other materials. It is to be inferred that where its mass, weight or consistency is inadequate for the shield method, it can be positively supplemented by an artificial blanket of clay dumped through the water and increasing the tunnel roof to the required thickness, the clay being afterwards dredged out if necessary.

The material has a certain degree of plasticity, enabling it to be penetrated by impact or pressure, as in pile driving, but is practically impervious and has sufficient tenacity to maintain a firm surface when kept under natural conditions. The upper part of the stratum close to the bottom of the river is of course much softer and more unstable than at greater depths where it is under heavier pressure.

Very dense, impervious clay of a somewhat similar nature was successfully tunneled under Boston Harbor with the aid of a roof shield only. This clay stood up well in vertical faces without bracing, but after a short exposure to the atmosphere it swelled so much as to produce tremendous pressure on the roof and side sheeting, often crushing the ends of the heavy timbers into the 12 x 12-inch sills.

One of the best known and important examples of subaqueous tunneling through river bed clay is that of the Thames tunnels, London, where the sedimentary material encountered closely resembles that under the Hudson river and behaves in a similar manner when excavated. Tunnels were successfully driven through it under atmospheric pressure, and without difficulty, many years before the Hudson river tunnels were commenced, and the material they penetrated has justly been considered as ideal for tunnel excavation.

Street Cleaning in Philadelphia to Be Reformed?

Those who have been watching for years to see Philadelphia abolish its old graft-burdened methods of collecting and disposing its refuse and of cleaning its streets have almost been forced to the conclusion that that desirable end would never be attained, or that, if temporarily attained, the grafters who have so long been bleeding the treasury through the Public Works Department would soon find means for returning to power and abolishing the more economic and efficient methods. Such well-wishers have been encouraged recently by the report of a committee of the City Council, which unanimously endorsed the administration ordinance to authorize the director of public works to make a study into the advisability of having the streets cleaned, and garbage, ashes and rubbish collected, by city forces. While this recommendation is for an investigation only, and it is possible, of course, for such investigation to condemn the project and thus furnish ammunition against the reform, we hope that public opinion, which is so difficult to arouse in behalf of the public in Philadelphia, will prevent any such outcome.

It may be said that the performing of such services by contract is not necessarily objectionable from the citizens' and taxpayers' point of view, but in this particular case the awarding of contracts for these purposes has become one of the greatest municipal disgraces to be found in the country. Each of these services requires an enormous equipment for a city as large as Philadelphia, while the disposing of the garbage requires a very expensive plant, which, if not used for this purpose, is of practically no value for sale or other use; and yet it had become the practice to delay advertising these contracts until a very few weeks before the letting (sometimes only two or three), and to let contracts for only one or possibly two years at a time, thus making it impracticable for any bidder to offer reasonable terms except those who were already doing the work and accordingly had the necessary equipment, or else those who felt satisfied that their pull with the powers in control would be sufficient in the future to guarantee their obtaining the contract for several years to come. No contractor could safely make a contract for one year, with no guarantee that he would be able to renew the contract for the succeeding year or years, without including in his price a sufficient amount to entirely reimburse himself for the cost of the equipment. This was one of the most outstanding features which condemned the Philadelphia system of awarding these contracts, but the politicians in control had numerous other methods of rewarding favorites, punishing those who rebelled against their control, and entirely eliminating from the competition those whom they did not favor.

It is true that, with the work done by city forces, opportunities for graft are by no means eliminated; but at least the contemptible politicians who have acquired millions through their control of these public services, although themselves holding no position in the government, will be required to reveal themselves, or the grafting methods can be traced more directly to the officials personally responsible for them, who can be gotten at directly by the votes of the public if not by the law.

Without being over-sanguine, we hope that this may be the beginning of a movement for the improvement of public service conditions in Philadelphia which will end in the public's finally casting off the strangling embrace of the two or three "old men of the sea" whom they have for years been carrying as unofficial recipients of a large share of their taxes.

Jamaica Bay Channel

The project for a 30-foot channel in Jamaica Bay, New York City, has reached a stage where only a strong public expression in its favor can save it, according to Senator Calder. With this in view, a meeting of representatives of commercial interests of the city was called March 31 by Commissioner Murray Hulbert. The Committee on Rivers and Harbors opposes the project on the ground that it is a new one. It also wants a promise that the Board of Estimate of New York will properly improve the land approaches. It is understood that $7,500,000 has been appropriated for this purpose contingent on immediate action on the part of the Federal Government.

Labor Notes

Some recent happenings and reports which have a bearing upon the subject of the labor supply available in the United States.

Because the strike violates a recent arbitration award, Denver building trades contractors have brought an injunction suit against three building trades unions which struck April 1.

The "outlaw" railroad strike which has collapsed after inflicting many millions of dollars damage on the public, was deliberately planned by radicals, I. W. W.'s and Bolshevicks, to cause the greatest possible injury to property and business. Ostensibly it arose from demands submitted by Chicago Yardmen's Association for increased pay per hour for conductors from present rate of 66 2/3 cents to $1; for switchmen from 62½ cents to 95 cents; for switch tenders, from 50 cents an hour to $5 per day.

The American Federation of Labor tried to maintain a safe position by the announcement of Samuel Gompers that it would try to help end the strike but that the men's grievances were real and must be adjusted.

Louis Marshall stated at a recent meeting of the National Conference on Immigration that "there is a shortage of labor to the extent of at least 5,000,000 men."

A free clearing house service has been established by the Baltimore Employment Managers' Association. Descriptive lists of workers in excess of demand will be furnished daily.

Shortage of Labor Serious at Marion, Ind.

In a recent letter to Public Works, T. E. Petrie, president of the Board of Public Works and Public Safety of Marion, Ind., says: I am sorry to state that this city has practically been on a standstill as far as new improvements are concerned for the last two years, owing to the high cost of material and labor as well as the shortage of common labor.

There were but four contracts let last year, 1919: one concrete alley, containing 427 square yards, and three sewers and two of the sewer contracts are not completed and have been carried over and will be completed this year. It has been practically impossible for the contractors to get help and they refused to bid on several sewer jobs that were up for letting. The city has been short of help for two seasons in the street cleaning department, also we have been short of help in our municipal water works plant and have, in order to keep the force, raised their wages at two different times. Common labor received 35c. per hour in the spring of 1919 and in the fall was from 45c. to 50c. per hour. I do not expect much street or sewer work in this city this year, owing to the high prices of material and labor.

Advanced Immigration Policy Recommended.

The National Conference on Immigration under auspices of Inter-Racial Council recommends the establishment of a Federal board of assimilation, to co-ordinate governmental activities relating to immigration, facilitate distribution of immigrants, supply them with information in securing employment, afford them instruction, and protect them against fraud and exploitation. It proposes modification of present exclusion laws by elimination of literacy test; advocating more extensive use of U. S. Consuls for advice.

Resolutions were passed urging that naturalization be permitted without exacting a compulsory preliminary declaration of intention and allowing for transfer of proceedings for naturalization from one district to another and for repeal of requirement of one year's continuous residence in State in which application is filed; that new laws be enacted to protect savings of immigrants; and favoring the establishment of bank departments affording special facilities for immigrant accommodation.

French Strike and Arbitration Laws.

The proposed French law to settle industrial disputes declares that, while right to strike is in no way denied, every possible effort to settle disputes by agreement must be made before work is stopped; in case of a dispute, employes affected must select delegation from their number, consisting of employes over twenty-one who have been at least six months in firm's employ, to meet with representatives of employers; in case of failure to agree, matter must be referred to arbitrator appointed by mutual agreement, or each side may name an arbitrator, or application may be made for arbitrator nominated by permanent conciliation committee of the trade concerned, or by the local *jude de paix*. In case of disputes connected with railways and other vital industries, conciliation committees must include representatives of the public to be appointed by Government. In case of failure to agree at preliminary meeting, a minute setting forth exact facts must be drawn and signed by both sides. Arbitration is made compulsory in public services.

The creation of a permanent national employment service to cooperate with states and municipalities is under consideration by the U. S. Secretary of Labor, who has requested the governors of all states to send representatives to a conference in Washington, April 23, 24 and 25.

Sewage Sprinkler Nozzles

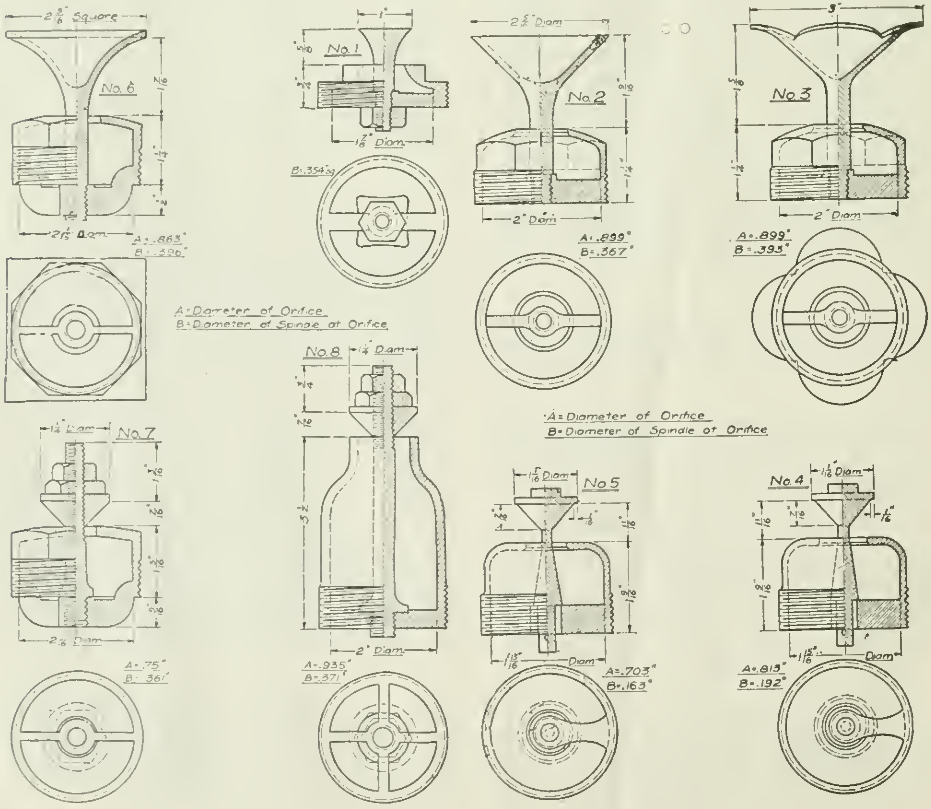
Coefficients of discharge of eight different kinds of nozzles were determined by experiments conducted at the hydraulic laboratory of Perdue University. In general, the coefficient for any one nozzle was found constant for heads exceeding 1.5 feet.

A series of experiments was conducted in the hydraulic laboratory of Purdue University by Professor T. W. Grove and W. E. Stanley, Instructor in Hyradulics, and C. E. Logan, civil engineer student in the university, the object of which was to determine the coefficients of discharge of several types of sewage sprinkler nozzles and obtain information necessary for selecting the best design of nozzles.

It was realized that a thorough investigation of the discharge from sewage sprinkler nozzles would necessarily include a study of the distribution of the discharge as well as the coefficient of the discharge. Because of abnormal conditions created by the war, however, it was decided to limit these experiments to a determination of the coefficients. (It is planned to conduct a series of tests on the distribution of flow later on.) Several experiments have been conducted in the past on the distribution of the discharge, among them those conducted at Rochester, Waterbury and the Massachusetts Institute of Technology.

Eight nozzles were experimented with, these being the following:

No. 1 Chase square nozzle,
No. 2 Taylor round nozzle,



SECTIONS AND PLANS OF NOZZLES USED IN THE EXPERIMENTS.

No. 3	Taylor square nozzle,
No. 4	Worcester round nozzle, 13/16" orifice,
No. 5	Worcester round nozzle, 11/16" orifice,
No. 6	Merrit square nozzle,
No. 7	Priestman-Beddoes round nozzle,
No. 8	Weand Atlantic type round nozzle.

No. 1 was given to the university by Mr. Chase, assistant engineer of the New York State Board of Health; Nos. 2 and 3 by the Pacific Flush Tank Company; Nos. 4 and 5 by Mr. Gault, superintendent of sewers of Worcester, and Nos. 6, 7 and 8 by A. Priestman of Philadelphia.

The accompanying illustration shows each of these in plan and section. Table No. 1 gives dimensions and areas of discharge openings in these several nozzles. (The base of the nozzle is the large end through which the water enters. The orifice is the opening in the smaller or discharge end. The spindle is the rod which supports the cone for affording proper distribution of the discharged water. In the first six nozzles the spindle and the cone are in one piece; while in the other two the cone works along a threaded spindle and may be set in any desired position.) The area of the orifice minus the cross-sectional area of the spindle is the net area of discharge.

TABLE 1.—DIMENSIONS OF DISCHARGE OPENINGS.

	Nozzle orifice		Spindle		Net area of discharge	
Nozzle No.	Diameter inches	Area square inches	Diameter inches	Area square inches	Square Inches	Square feet
1	....	.6000	.354	.0984	.5016	.00322
2	.899	.6348	.367	.1058	.5290	.00367
3	.899	.6348	.393	.1213	.5135	.00357
4	.813	.5191	.192	.0290	.4901	.00340
5	.703	.3882	.163	.0209	.3673	.00255
6	.863	.5849	.396	.1232	.4617	.00321
7	.750	.4418	.361	.1024	.3394	.00236
8	.935	.6866	.371	.1081	.5785	.00402
†7a	.750	.4418	.584	.2679	.1739	.00121
*8a	.935	.6866	.596	.2790	.4076	.00283

†Applies also to 7b and 7c. *Applies also to 8b and 8c.

APPARATUS EMPLOYED.

A wooden box 4 feet square by 3 feet 6 inches high was suspended from the ceiling. A 4-inch pipe 8 feet long passed through the bottom of this box, and through this was forced the water which was used in the experiments, which water was furnished by a centrifugal pump. At the top of this pipe was a 4-inch to 3-inch reducer, followed by a 3-inch to 2-inch reducer, and the nozzles were screwed into the last named. A quarter-inch pipe was tapped into the 4-inch pipe at a point just below the large reducer and was connected to a glass tube mounted alongside the tank, which served as a piezometer. By means of a tape mounted behind the piezometer, the elevation of the water column could be read directly to thousandths of a foot with the aid of an index pointer and attached vernier. Water sprayed from the nozzle fell into the wooden box and was led from this by a drain pipe into a weighing tank set on a platform scales immediately below.

The elevation of the water column in the piezometer above the base of the nozzle was taken as the total head acting on the nozzle. The velocity of approach was negligible, being equal to 1.007 feet per second for the maximum flow of 0.0879 cubic feet per second. The corresponding velocity head was only 0.0157, while the pressure head was 10.97 feet.

MAKING THE TESTS.

Each nozzle was tested under heads ranging from one to eleven feet, the flow being regulated by a valve in the pipe bringing the water to the apparatus. Five readings were taken for each run, and the average of these used. In addition, there were recorded time, initial and final weights of water, and temperature of water. As the last remained practically constant, it was not considered in the computations.

The calculations were made on the theory that the quantity discharged is equal to a coeffcient times a $\sqrt{2gh}$, and a, h and q being ascertained, the coefficient C was calculated. It was found that, using the equation $q = m(h)^n$, the values of m and n were constant for any one of the first seven nozzles.

In testing nozzles 7 and 8, the position of the cone was varied, four positions being used, namely, the bottom of the cone placed ⅛ inch below the top of the orifice, on a level with the orifice, 1/16 inch above the orifice and ⅛ inch above. The rate of discharge, of course, increased as the cone was raised. For instance, with a head of 11 feet on Nozzle No. 7, the discharge in gallons per minute was about 8.8 for ⅛ inch below, 16 for the same level, 16.4 for 1/16 inch above, and 16.7 for ⅛ inch above.

CONCLUSIONS.

The conclusions drawn from the experiments are set forth in the report (which is published as Bulletin No. 3 of the Engineering Experiment Station of Purdue University) as follows:

The relation of the logarithms of head and discharge can be represented by a straight line for all nozzles tested, with the exception of Nozzle No. 8.

It is essential that care be taken in fixing the position of the cone in adjustable nozzles. Lowering the bottom of the cone below the level of the orifice has a more serious effect upon the rate of discharge than does the raising of the cone above the same level. This is brought about by the fact that the net area of the discharge opening is decreased as the cone is lowered.

The coefficient of discharge remains constant for all nozzles except No. 8, when the head is greater than 1.5 feet.

The rate of discharge for nozzle No. 6 may be increased by reaming the inner edge of the orifice.

The report contains eighteen tables, giving the various figures obtained by the test. One of these tables gives the dimensions of the discharge openings, the second gives the determination of piezometer readings for zero head, while one table is devoted to the results obtained for each nozzle, including a table for each of the four positions of Nos. 7 and 8. Table No. 18 gives the values of the coefficients of discharge for each of the nozzles except Nozzle 8. This coefficient C was as follows:

For Nozzle No. 1, 0.648; for No. 2, 0.756; for No. 3, 0.696; for No. 4, 0.666; for No. 5, 0.675; for No. 6, 0.598; for No. 6, after it had been reamed out on the inside of the orifice, 0.668; for No. 7, in the four positions indicated, 0.569, 0.599, 0.586 and 0.591, respectively.

As an illustration of the data tabulated for the several nozzles, we give herewith that for the Worcester round nozzle, No. 4.

CALIBRATION OF WORCESTER ROUND NOZZLE, 13/16-INCH ORIFICE.

Gage correction = 0.515 feet. Temperature of water = 73° F.

	Time	Discharge			Head		
Run	seconds	Pounds	CFS.	GPM.	Obs. feet	Cor. feet	C.
39	180	178	.0159	7.14	1.341	.826	.643
40	150	211	.0226	10.1	2.082	1.567	.663
41	150	269	.0288	12.9	3.068	2.553	.662
42	149.6	322	.0345	15.5	4.155	3.640	.663
43	150	356.5	.0381	17.1	4.951	4.436	.664
44	150.2	394.5	.0421	18.9	5.88	5.37	.667
45	149.4	435	.0467	21.0	7.08	6.57	.669
46	150.2	457.5	.0488	21.9	7.73	7.22	.666
47	150.6	498.5	.0531	23.8	9.01	8.49	.668
48	150	528	.0564	25.3	10.05	9.53	.670
49	150.6	570	.0607	27.2	11.57	11.05	.670
50	150.6	130	.0138	6.20	1.143	.628	.639

National Highway Policy

Points to be placed by the Federal Highway Council before the platform builders of the dominant political parties for favorable action at their respective conventions.

It has been and is the policy of the Federal Highway Council to advocate a national system of highways to be built and maintained at the expense of the Federal Government, under the supervision of a Federal Highway Commission, and to extend and continue Federal Aid after 1921, thereby encouraging and assisting the states to connect up their state systems with the nation system, making both more effective, and to issue such literature as may be helpful to the counties in solving their road problems.

The Federal Highway Council believes that it is the duty of the Government to take over about 60,000 miles of the main highways to construct and rebuild, where necessary, as a national system, the States to take over 240,000 miles as a main state system, and the counties to take over about 300,000 miles of market county roads, making a system of about 600,000 miles, of which between 200,000 and 250,000 miles have been improved, and leaving between 300,000 and 350,000 miles to be improved.

DEVELOPMENT OF STATE HIGHWAY DEPARTMENTS.

The highway problem, during the last century, has grown so extensively that the communities under whose supervision it came could not satisfy its needs, and it was necessary for each county to try and supply the want that the community failed to satisfy. As the country developed and traffic increased, the country could not cover the broad need, and therefore state aid was extended to the county by the state. But this in turn did not satisfy traffic demands. It was not a great while before the state realized that a more powerful unit should step in and take over a certain number of miles of road and build a state system, so State Highway Departments were formed. The need was met as far as the state conditions were concerned, but due to the great increase of traffic brought about by the advent of the motor vehicle, the Government realized that to properly take care and develop interstate traffic on the highways, it would be necessary for the Government to co-operate with the states by appropriating money to assist them in their road building program. Congress passed an act appropriating a large sum to assist the states in building their main roads and to properly establish an efficient State Highway Department.

FEDERAL AID.

Federal Aid has been a great stimulant to the road building program of the country, and whereas up to the present time there has been only a limited amount of road building completed, yet a great good has been brought about by requiring the establishment of a State Highway Department in each state, and by encouraging the counties to enter on a larger road program.

The Federal Highway Council is of the opinion that Federal Aid should be continued and extended until all the State Highway Departments have been well organized and on a firm, financial and efficient basis, yet it realizes that regardless of how efficient the State Highway Department may be, there still exists a want that it will be impossible for them to satisfy, even with the assistance of Federal Aid, and that want is a national system of highways. A system to be constructed and maintained by the Government under the supervision of a Federal Highway Commission, whose sole duty it will be to devote their energy and time to this work, and administer Federal aid.

STATE COOPERATION.

Officials and others concerned in highway development assert that it is impossible to expect forty-eight states and the District of Columbia operating under forty-nine different units to co-ordinate their plans and systems so that a national system would be constructed in the least possible time, especially when there is no one who has the power or authority to bring these forty-nine different units into accord. Each State Highway Department is independent to act and build the roads that will be of the greatest commercial advantage to its state, regardless of whether such road will be a link in the national system or not. It cannot be expected, they say, of a state highway engineer to devote his time and energy in studying the road conditions of an adjacent state and the states beyond, which would be of great value from a national standpoint. It is his duty to devote his time and energy to conditions in his own state that will be of the greatest value locally but which may not form the main connecting link in the national system.

GOVERNMENT CONTROL.

Therefore, the Council is firmly of the belief that it is the duty of the Government to step in and establish a national system of highways, create a Federal Highway Commission to take charge of their construction and maintenance, and to administer Federal aid. It also believes that Federal aid should be extended to the states, helping the State Highway Departments to build up their state systems, thereby making the national system more effective and doing the greatest good. Federal aid should by all means be continued until at least this result is accomplished.

Every effort should be made to speedily enact national highway legislation, providing for the construction and maintenance by the Federal Government of a national system of highways, creating a Federal Highway Commission, and in 1921 make an additional appropriation for the continuation of Federal aid.

Federal Public Works Department Referendum

A long step towards the creation of a department of public works headed by a member of the cabinet and providing for the transfer of all kinds of engineering and building construction work from the Department of the Interior and other departments through which it is now so widely scattered, as proposed by the Jones-Reavis Bill, has been made by the Chamber of Commerce of the United States announcing a referendum of the question, as proposed by the National Public Works Department Association.

This action results directly from the petition submitted to the Chamber of Commerce by the Engineering Council representing the American Societies of Civil, Mining, Mechanical and Electrical Engineers and the Metallurgical Engineers and the Society for Testing Materials. The council has studied this question through a committee headed by Chas. Nagel, formerly secretary of Commerce and Labor.

In this action, the Chamber of Commerce is cooperating in a general plan to secure the support of representative commercial and civic organizations for the promotion of economy and efficiency in government business. The plan for a Department of Public Works is vigorously supported by more than 100 engineering societies representing every state and many of the large cities and having a membership of more than 100,000, as well as by the Associated General Contractors' of America and many state and local contractors' organizations. There is yet to be presented any serious objection to the plan and with the very strong and influential efforts in its behalf there now seems to be good reason to hope for the establishment of a National Department of Public Works.

Municipal Street Cleaning in Philadelphia

The committee of city property of the City Council of Philadelphia unanimously voted to refer with favorable recommendation to the finance committee the administration's ordinance to authorize the Director of Public Works to make a study into the advisability of the city doing its own cleaning of streets and collecting of garbage, ashes and rubbish, and to provide $25,000 for that purpose.

Among the suggestions made in the course of the discussion was increasing the number of street cleaning districts to procure greater competition, cleaning from houseline to houseline, and making a practical experiment by taking over one district for a period of one year.

Good Roads Week

More than 100 cities throughout the United States have already arranged to participate in the observance of "Ship by Truck-Good Roads Week" commencing May 17.

A national program has been mapped out and endorsed by the governors of several states and the chief executives of many cities, who will urge consideration of highway improvement and highway transportation plans. Every effort will be made to demonstrate the value of the highways to meet increasing needs for certain and economical transportation for short distances and the development of highways as an integral part of the national transportation system.

An impressive demonstration of high possibilities is planned by the simultaneous operation, from all of the principal cities participating, of motor truck trains starting at a given time on territorial tours and transporting pre-arranged loads from city to city and from the farms to the city markets. Many open-air meetings are planned that will promote both the motor truck service and the coordinated improvement of highways, the development of through lines and feeders, and hard surfacing of roads.

Coordinating Labor and Employers With the Public

In a recent address to the Associated General Contractors of the Pacific Northwest, George C. Mason, Portland, Oregon, strongly advocated the representation of the public in capital and labor negotiations. Such action would greatly increase public confidence and satisfaction and might, he believes, be promoted by a plan recently formulated by the industrial relations committee of the Portland Rotary Club which is universally applicable for both the union and non-union organizations and partakes of a shop committee plan that has been highly developed and is generally successful in England and assists essentially the establishment of frank and fair communications between the employer and the committee of employes. He said: "The price we have to pay for industrial peace and industrial efficiency is that we shall lay aside some of our self-assertive individualism and some of our class consciousness and get rid of our conflict-attitudes and subordinate our pugnacious instincts. If we want democracy, we can have it, and unless much of our talk about democracy is to be open to the charge of insincerity, we must desire some form of industrial democracy, but to get it we must develop a new machinery and acquire a new spirit. The fundamental principle underlying this new spirit must be cooperation, frankness and fair play."

Can Engineers Prepare Contracts in New York?

The New York Court of Appeals recently handed down an opinion which seemed to restrict the drawing of legal documents to persons possessing the right to practice law. This raised question in the minds of some engineers as to whether engineers and architects could continue in New York State to prepare contracts and certain other legal or semi-legal documents as has been their practice hitherto. On request of the American Society of Mechanical Engineers for information on this point, Engineering Council submitted the question to the law firm of Parker & Aaron, which replied as follows:

April 15, 1920.

Alfred D. Flinn, Esq., Secretary,
Engineering Council.

We have your inquiry of March 16 calling our attention to the decision recently rendered by the Court of Appeals, Judge Crane writing the opinion. The decision referred to is that of People vs. Alfani, 227 N. Y., p. 334. In that case there was evidence, as the chief Judge said, "consisting of defendant's sign and repeated acts which permitted the trial court to find that the defendant held himself out to the public as being entitled to and did practice law." Defendant had a sign up advertising himself as a Notary Public and as a person drawing "all legal papers." The evidence showed that he did draw a bill of sale and chattel mortgage and advised as to the necessity of filing the mortgage in the County Clerk's Office and that he charged and received $4.00 therefor. When the client was leaving he inquired of the defendant, "In case I have any trouble of any kind and I need any legal advice, can I come back to you?" to which the defendant replied "Yes."

In People vs. Title Guarantee & Trust Co., 227 N. Y., p. 366, a similar question arose in the prosecution against the Title Guarantee & Trust Company for drawing deeds and similar instruments in connection with their business of insuring titles to real estate, and the court held that such action did not violate the statute. The Court says:

"We know that in cities constantly men engaged in the real estate business and banks have prepared for their customers such instruments without doubt or criticism.

"The legislature when it enacted not only Section 280 of the Penal Law, which we have been considering, but also Section 270 relating to the practice of law by an individual without being admitted and registered, was charged with the same knowledge of prevailing customs and practices with which we are chargeable. Its members knew, oftentimes doubtless by practical and personal observation and experience, that laymen throughout the state were rendering such services as are here involved. Not only by practice and custom but by inherent privilege they had the right to do this unless forbidden by statute, and if the legislature intended to prohibit a widespread practice and establish a new rule it was its duty to say so clearly and unmistakably in the statute relating to the practice of law and rendition of legal services by individuals. It did not say so and in my opinion there is not to be found in that section of the Penal Law any provision against the rendition of such services by an individual. We think the same idea is emphasized as in Section 280 that an individual who is not admitted to practice must not assume the character of an attorney at law. He is forbidden to practice or appear 'as an attorney at law or as an attorney and counselor at law' or to make it a business to practice 'as an attorney at law or an attorney and counselor at law' or to hold himself out to the public as being entitled 'to practice law as aforesaid or in any other manner' or 'to assume to be an attorney or counselor at law.' But there is nothing which can fairly be regarded as indicating an intention to abolish an existing and widespread practice and to prevent a layman as such and without any simulation of or pretense to the character of an attorney from drawing a simple instrument as instructed by his customer and not involving or predicated upon any legal advice then given."

Engineers having special knowledge of the engineering work required and the professional skill enabling them to express it, are not precluded as an incident in the practice of their profession from preparing "contracts for engineering work as has been the common practice for years." By so doing they are not holding themselves out as practicing law and are not practicing law.

Very truly yours,
(Signed) Parker & Aaron.

Bridging the Delaware at Philadelphia

With an ordinance sent to the city council that would ratify the act of the Assembly of last year, providing for the building of a bridge across the Delaware river at Philadelphia and a joint interstate commission to supervise the work, Mayor Moore of Philadelphia submitted three cost estimates prepared by George S. Webster, chief of the Bureau of Surveys. The first, for a bridge 8,500 feet long with a straightway approach, amounted to $37,100,000, $28,960,000 for construction and $8,140,000 for damages. New Jersey's share would be $17,500,000 and Pennsylvania would pay $19,600,000. This estimate is subject to slight modifications because of undetermined factors of location, type of approaches and depth and character of rock at the site of the main piers. A second estimate was $56,270,000, the total cost of construction and damages in connection with a bridge with approaches beginning at Fourth and Spruce streets and Fourth and Vine streets. Of this cost New Jersey would pay $19.590,000 and Pennsylvania $36,680,000. The third estimate, for a bridge with an approach in Philadelphia commencing at Sixth and Market streets, including the cost of widening Market street and the opening of two diagonal streets, amounts to $66,590,000, of which New Jersey would bear $19,590.000 and Pennsylvania $47,000,000.

New Jersey-Manhattan Tunnel

Gen. George R. Dyer, chairman of the New York State Bridge and Tunnel commission, has explained why the Jersey City-Manhattan tunnel will have only two lines of traffic.

According to estimates carefully prepared, the capacity of the tunnel in 1924, the date of its opening, will be almost three times as great as the traffic. The cost of building for three lines of traffic would be nearly double that of two.

Ample plazas and approaches have been provided to allow for an uninterrupted flow of traffic; but these approaches are not able to take care of more than two lines of traffic, so that it would be useless to have three lines. To increase the size of the approaches would be an enormous expense to the state, and the money so expended could better be devoted to the construction of a second series of tunnels at another part of the river.

Well Pumping in Savannah

Wells have been used as source of supply for thirty-five years. As yield diminished, air lift was used. The city is now changing to electric pumping from five wells, figuring a less cost than by steam pumping.

Savannah, Ga., began using well water for its public supply shortly after 1880, and by the end of 1887, fifteen wells had been bored near the river pumping station, where river water had been obtained previously. As these wells failed to furnish sufficient supply, in consequence of which river water was mixed with the well water, a new site was selected about two miles distant, where twelve wells 300 feet apart were carried to a depth of 500 to 600 feet. A 12-inch casing was driven for about 250 feet, where it was embedded in rock. These wells discharged into a brick conduit 6 feet in diameter and constructed twelve to sixteen feet below the surface of the ground, which conduit carried the well water to the pump well. This station was known as the Gwinnet Street pumping station. The equipment here consisted of two Holly-Gaskill engines of 12,000,000 gallons capacity each, which maintained the pressure continuously, there being no standpipe or reservoir. This pumping station has been in continuous use since 1893.

The wells at the Gwinnet Street station were at first self-flowing, but the flow gradually lessened, and an air-lift plant was installed in 1902 consisting of two Ingersoll-Rand air compressors of 1,800 cubic feet capacity per minute. In 1908 a 1,200 cubic feet air compressor was installed at the river station, which was operated only during the day, except when a peak load had to be provided for.

When artesian wells were first driven in Savannah the water rose to from 30 to 35 feet above mean low water, but with continuous draught upon the ground water, the static head dropped at least 20 feet to 25 feet at the river station within three years after they were put in operation. At the Gwinnet Street station the static head of the wells was 12 to 14 feet below mean low water in 1918, although in 1890 the head was approximately 28 feet above mean low water. When the wells were first bored at the Gwinnet Street station, the total flow from the 12 wells was 10,300,000 gallons a day. This diminished to 9,500,000 gallons within two years and in 1897 had been reduced to 5,500,000 gallons. In 1902 flow was about 5,000,000 gallons, but when the air-lift was introduced in that year the capacity was increased to 10,300,000 gallons. In 1915 E. R. Conant found that they were yielding 15,000,000 gallons a day.

More recently the city has begun changing the method of pumping the wells, and expects within a few months to abandon the Gwinnet Street pumping station for regular service, keeping it in reserve with fires banked for fire or other emergencies. In place of the former method of pumping, they are installing electric pumping plants, one being located at each well. The pumps used are those provided by Layne and Bowler Company. These consist of a deep-well pump operated by an electric motor, the latter being at the surface of the ground immediately over the well, while the pump itself is 140 feet below the surface. In the case of most of the wells, the motor is placed a few feet below the surface, in a vault provided for the purpose. These pumps discharge directly into the mains at 65 pounds pressure. They will be installed at five stations distributed throughout the city instead of concentrated at one point. Two such stations have now been operated for fifteen months, one for a shorter period, and the other two will it is expected, be in operation by the end of the year. During the fifteen months that the wells have been in service, there has been an interruption of current of not to exceed fifteen minutes total, according to L. A. East, superintendent of water works.

Electricity is purchased by the city at ¾ of a cent per kw. h., and the experience with operating the two plants shows that this will make the cost of pumping about $12 per million gallons, this covering overhead and all expenses. Pumping by steam at the Gwinnet Street station is now costing $27 per million gallons. The consumption by the city averages 13½ to 14 million gallons per day. In September, 1919, the river station was abandoned. As soon as the other two wells are completed, all the pumping will be done by them, the Gwinnet Street station, as already stated, being reserved for emergency purposes only.

The annual report of Mr. East for the year 1919 shows that one of the electrically operated wells, known as No. 10, was in operation since the early part of June and pumped approximately 1,200,000 gallons in a day of 24 hours. In regular operation, however, it has been operating between 12 and 14 hours a day and pumping about 700,000 gallons. Altogether, during June to December, inclusive, this well pumped 149,800,000 gallons. Well No. 13 began operation in the early part of January and was put in full operation in May. This well was found to yield about 2,000,000 gallons in 24 hours. Well No. 17 began operating on the 17th September, and on the following day pumped 4,000,000 gallons of water. This well is 519 feet deep, the 24-inch casing extending to a depth of 110 feet, from which point a 16-inch casing was carried to water. This water is said to be softer than any artesian water the city had previously obtained. It is expected that the discharge of well No. 17 will be equaled by that of each of the two that are not yet completed.

The municipal dock at Trenton has proved of great value during the recent railway strike by permitting a large quantity of goods to be shipped in and out of the city by way of the river when the railroads were too congested or unreliable for adequate service. The dock has been loaded to capacity and the employes have worked day and night to handle the incoming and outgoing freight.

Recent Legal Decisions

ENFORCEMENT OF LIENS.

(Okl.) In suit by subcontractor to enforce a lien against owner of building, the owner may set off any actual damages sustained by contractor's failure to complete building in time, if they are such as were in contemplation of parties when contract was made, in view of Rev. Laws 1910, § 3864.—J. B. Klein Iron & Foundry Co. v. A. B. Mays & Co., 184 P. 577.

(Cal. App.) In actions to foreclose mechanics' lien, defendants, having failed to answer, and thus to put in issue all material allegations of the complaint, particularly those setting forth the contents of the liens, thus having admitted the truth of the allegations, *held* estoppel to raise the question of variance between the claim of lien and the proof.—Krenwinkel v. Henne, 183 P. 957.

(Okl.) In action against owner to enforce a subcontractor's lien, evidence of owner's payments to contractor, who in turn paid money to the subcontractors, etc., during the 60 days within which they otherwise would have been entitled to file liens, was admissible.—J. B. Klein Iron & Foundry Co. v. A. B. Mays & Co., 184 P. 577.

SUBCONTRACTS.

(La). Where a bond of a municipal subcontractor, although reciting it was made in favor of materialmen, was expressly conditioned "for the * * * performance of said contract and the payment of all subcontractors under said subcontractors," one furnishing material to subcontractors had no right therein, in view of City Code, art 3039, as to strict construction of suretyship obligations.—Carolina Portland Cement Co. v Carey & Boettner, 82 So. 887.

(La.) A contractor to whom a sewerage and water board had awarded a contract was not obliged to exact a bond from subcontractors, and incurred no contractual obligation to parties furnishing material to a subcontractor and no law imposed any obligation upon him in favor of such parties, for Act. No. 134 of 1906, providing that the owner shall require of the contractor a bond for payment of furnishers of materials, etc., does not apply to the case of contract between contractor and subcontractor.—Carolina Portland Cement Co. v. Carey & Boettner, 82 So. 887.

A contractor is in no way to blame for having settled with subcontractors without having made a reservation for the claim of one furnishing material to the subcontractor, where he had no knowledge of the existence of the debt, and such party gave notice of it only some 60 days after completion of the work.—Id.

CONTRACTS FOR PLANS.

(Cal. App.) The board of public works of the city and county of San Francisco was authorized to contract with an architect for the preparation of plans and specifications for a projected school house at the usual rate of compensation for such services in the city without calling for bids and awarding the contract to the lowest bidder.—Miller v. Boyle, 184 P.421.

CONTRACTOR'S RIGHT TO BARRICADE.

DAVIS vs. MELLEN, Utah 182 P. A. C. 920. A contractor who works on a highway for the purpose of improving the street has the right to barricade and obstruct the public travel over the section of the street being improved.

HIGHWAY SUBCONTRACTOR NEED NOT FILE CLAIM WITH COUNTY AUDITOR.

(Ind.App.) A subcontractor for highway improvement may recover on the contractor's bond without filing his claim with the county auditor, pursuant to Burns' Ann. St. 1914, §§ 5901a, 5901b. —U. S. Fidelity & Guaranty Co. of Baltimore, Md., v. State, 125 N. E. 420.

SURETY BONDS COVER ROAD LABOR CLAIM.

(Mich.) Bonds given by defendant casualty company as surety for the assignee of road contracts, in so far as concerned graveling of the roads, *held* to cover a claim for labor on which the person who furnished it recovered against plaintiffs, the original road contractors, assignors to defendant casualty company's principal, on the latter's failure to pay.—Sullivan v. Fidelity & Casualty Co. of New York, 175 N. W. 397.

Where a casualty company, by its bonds given to assignors of road contracts, in effect agreed to make good any default of its principal, the assignee, so far as concerned graveling, in making payment for labor furnished, the fact that the damages on account of its liability in each of the bonds are not shown as separate items in an action by an original contractor personally and as assignee of the other contractor does not relieve the casualty company, in the absence of dispute as to the entire damage sustained by the original contractors through its principal's failure to pay.—Id.

In suit by original road contractors to recover from the surety of their assignee of the contracts, in so far as graveling work was concerned, amounts paid on account of a judgment against them for labor furnished, evidence *held* insufficient to show that the assignee of the contract was overpaid, in violation of the terms and conditions in the surety's bonds, so that the surety was released.—Id.

CITY CANNOT APPROPRIATE CONTRACTORS' PROPERTY.

(Ky.) City, having refused to permit contractors to proceed with street improvement work under void contract, had no right to appropriate piping and tiles, which contractors had intended using in performance of contract and left upon ground of street upon discontinuance of work, since city, having repudiated contract, could not rely thereon for purpose of keeping material which would have gone into improvement.—Staebler & Gregg v. Town of Anchorage, 216 S. W. 348.

NEWS OF THE SOCIETIES

May 4-6.—NATIONAL FIRE PROTECTION ASSOCIATION. Twenty-fourth annual meeting will be held in Insurance Exchange Auditorium, Chicago. Secretary, F. H. Wentworth, 87 Milk street, Boston.

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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AMERICAN WATER WORKS ASSOCIATION.

Tentative program of the 40th Annual Convention, Windsor Hotel, Montreal, Canada, June 21-24, 1920.

MONDAY, JUNE 21.

Registration, meetings of commitmittees.

Informal reception, dancing.

TUESDAY, JUNE 22.

Opening of convention at 9 o'clock. Reading of Papers.

The Municipal Water Supply of Montreal, by Thomas W. LeSage.

The Works of the Montreal Water and Power Company, By F. H. Pitcher.

These two papers will give a good idea of the dual water supply of Montreal, part municipal and part private, two unusually interesting water works systems, one of which produces chlorine in its own electrolytic plant.

The Experience of Montreal in the Manufacture of Alum, by James O. Meadows.

The Water Works of the City of Quebec, by Arthur Surveyor.

The cold weather problems in this city, including the maintenance of efficent fire protection service in winter, are extremely difficult and the topography of the city presents many unusual features in the distribution of water.

Water Supply Problems in the Province of Quebec, by T. J. Lafreniere.

The Water Works of St. Johns, New Brunswick, by Frank A. Barbour.

Water Works experiences, by Beekman C. Little.

Economic Features of Pumping Station Operation, by Leonard C. Day.

Difficulties in Building the Louisville Pumping Station, by James B. Wilson.

WEDNESDAY, JUNE 23.

The New Water Supply of Winnipeg, by James H. Fuertes and William G. Chase.

President's Address, by President Carleton E. Davis.

Reports from Sections.

Report of the Association's Representatives on the American Electrolysis Committee.

Report of the Committee on Private Fire Protection Services, Nicholas S. Hill, chairman.

Report of the Committee on Official Standards for Water Analysis, Jack J. Hinman, Jr., chairman.

Report of the Committee on Standard Specifications for Cast Iron Pipe and Specials, Frank A. Barbour, chairman.

Report of the Committee on Cold Weather Troubles, Charles R. Bettes, chairman.

Reports of Officers and Standing Committees.

Nomination of Members of the Nominating Committee.

Selection of Place for Holding the 1921 Convention.

Entertainment, probably a trip through the rapids of the St. Lawrence River.

A smoker for the men and for the ladies a theatre or card party.

THURSDAY, JUNE 24.

Superintendents' Day.

Discussion of the selection, installation, reading and maintenance of Water Meters. All members having experiences in this work, especially anything out of the ordinary are requested to communicate with the Editor,

Mr. John M. Goodell,
106 Loraine Ave., Upper Montclair,
N. J.

or to prepare and send to the editor a short practical paper or a discussion to be presented at the convention, or come to the convention prepared to relate some experience.

Chemical and Bacteriological Section.

This Section is preparing a program for a separate meeting Thursday. At this meeting a paper will be read by Colonel George A. Johnson introducing the subject of the quality of water.

A general discussion of the legitimate uses of water, what they are and how to estimate them. There has been much discussion on Water Waste and how to prevent it, but up to the present time little on its Legitimate Use. Some cities have been criticised because of the high per capita consumption without knowledge of the legitimate uses of water in that particular place.

The discussion will embrace private sources of industrial supplies; the nature of the demand for water by different industries, the actual demands of water for domestic consumption by families of different means.

Damage of Deep Wells by Sea Water, by Dr. William P. Mason.

Cost-Plus Contracts in Water Works Construction, by George W. Fuller.

Standard Forms for Contracts, by G. W. Buchholz.

The Trend of Prices, by Leonard Metcalf.

Arrangements are under consideration for trips about the city of Montreal, and for a trip by special boat leaving Montreal Friday evening for the Saguenay River.

The above program will be revised and added to.

Carleton E. Davis, President.

J. M. Diven, Secretary,
153 West 71st St.,
New York, N. Y.

Seventh National Foreign Trade Convention.

The important convention to be held in San Francisco, May 12-15, under the auspices of a National Foreign Trade Council, has published a very comprehensive program of topics to be considered in 12 groups taking up education, geography, finance, advertising and various other subjects, one of the most important of which to construction interests is group third, Transportation and Communication. The officials for this group are:

Chairman, R. M. Calkins, vice-president, Chicago, Milwaukee & St. Paul Ry.; vice-chairman, E. L. Jahncke, president, Jahncke Drydocks Corporation; secretary, J. Hubbert Cullen, Detroit.

The principal addresses announced are:

Export and Import Transportatino, R. M. Calkins, vice-president, Chicago, Milwaukee & St. Paul Ry.;

Port and Terminal Facilities, B. F. Cresson, Jr., New York-New Jersey Port and Harbor Development Commission; Communications, Gordon C. Corbaley, Seattle Chamber of Commerce; Oriental Trade Expansion Dependent Upon Transportation Development of Asia, Paul P. Whitham, Trade Commissioner, Department of Commerce.

Brooklyn Engineers Club.

At a regular meeting, April 29, Howard P. Quick presented a paper, illustrated by lantern slides, on "The Development of the Electric Tramway, Light, Power, Gas and Telephone Public Utilities in the Largest Two and Principal Cities of Brazil—Sao Paulo and Rio de Janeiro—and Their Successful Operation under One Management."

It discussed events leading up to the undertakings, handicaps in Latin-American engineering and pre preliminary investigations. It described at Sao Paulo—City Work—American Standards—Hydro-Electric Developments—Gas and Telephone Services—Reserve Steam Plant; and at Rio de Janeiro—City Improvements and Electric Developments—Old Transit Facilities—Organization and Preparation of New Undertakings—Unification of Tramways—Types of Cars—Hydro-Electric Developments—Terminal and Sub-Stations—Reserve Steam Plants—Underground Distribution—Special Undertakings—New Gas Works and New Telephone System Developments.

American Society of Engineers.

Preparations are being made for a large attendance at the sixth annual convention at the Planters Hotel, St. Louis, May 10 and 11, which it is expected will be addressed by a number of prominent men including: M. O. Leighton, chairman of the national service committee of Engineering Council, who will speak on "Getting Salaries for Public Service Engineers Into Budgets," Frances A. Kellor, vice-chairman of the Inter-Racial Council of New York and a recognized authority on immigration and racial problems, who will speak on "The Manpower Engineer—The Opportunity of Americanism" and Fred Lavis of the American International Corporation of New York who will speak on "Opportunities for the Engineer."

The principal speakers at the banquet on May 11 will be Doctor F. H. Newell, president of the American Association of Engineers and head of the department of civil engineering at the University of Illinois, and L. K. Sherman, president of the United States Housing Corporation.

Following schedules, endorsed by the directors, of salaries for state highway engineers and county highway engineers, there has just been issued a comprehensive national schedule for engineers in public service, including assistants, engineers and officials, from rodmen and chainmen at an annual salary of $1,200 to commissioners of departments at a salary of $15,000. A schedule has been prepared by chairman S. T. Hadden, and a committee of 23 members widely scattered throughout the country all of whom actively participated by correspondence and submitted entirely independent data irrespective of the attitude of other members of the committee. It is expected that the schedule will be adopted at the directors' meeting May 9.

The Nashville Club was organized April 8, Matt M. Bird, secretary.

The students' chapter of the A. A. E. at the university of southern California has petitioned for a charter.

National Association of Railroad Tie Producers.

The first annual convention was held April 22 and 23 at the Hotel Sherman, Chicago. Among the principal papers and addresses were:

Practical reforestation with especial reference to financial return, Mr. Howard Andrews, director; The railroad situation and American industry, Samuel O. Dunn, Railway Age; Production of cross ties on Pacific Coast, E. M. Blake, vice-president; Manufacture of cross ties with portable saw-mills, and its possible influence on future cross tie prices, R. J. Witherell, director; A proposal for a central inspection bureau, Warren C. Nixon, and Demand for hardwood lumber and its effect upon the value of standing timber heretofore used for the manufacture of cross ties, General L. C. Boyle, Washington, D. C.

PERSONALS.

Campbell, G. A., has been appointed member of the Nevada State Department of Highways.

Ellis, J. R., has been made principal assistant engineer to W. L. Winter, civil and hydraulic engineer, Forth Smith, Ark.

Bauma, W. H., has been appointed county highway commissioner and surveyor of Thayer County, Neb.

Christhilf, A. E., has been appointed chief engineer of the Annex Improvement Commission of Baltimore.

Dewey, Edwin P., has been appointed city engineer of Pasadena, Cal.

Mead, Prof. Daniel W., of the University of Wisconsin, has been appointed consulting engineer to the Grand River Drainage District of Livingston County, Missouri, on flood prevention plans prepared by the Morgan Engineering Company, Memphis.

Restall, C. H., has been appointed chief engineer of streets and engineering for the city of Boston.

Hockaday, J. W., has been appointed superintendent of water works at Clebourne, Texas.

Toner, J. A., has been appointed superintendent of public works of Meriden, Conn.

The firm of Ball & Snyder has opened a consulting engineering office in New York City.

Knowles, J. H., formerly chief engineer Western Pacific Railroad, has opened a private engineering office in San Francisco.

Ryckman, J. H., is designing engineer for the Department of Public Works, Chicago.

Heidel, C. S., has been appointed state engineer of Montana.

Hanna, David, has been made superintendent of waterworks, Winsaw, Ontario.

Shepard & Wolf have opened a consulting engineering office for municipal and sanitary work at St. Paul.

Spratt, T. A., has been appointed temporary superintendent of the Ottawa Suburban Road Commission.

Givan, Albert, has been appointed assistant state engineer of California.

Herrold, George H., has been appointed managing director and engineer of the St. Paul City Planning Board.

Newell, J. P., Portland Ore., president of the city planning commission, has resigned to accept an important commission with the Canadian government in preparing engineering data prior to the taking over of the Grand Trunk Railroad,

Goff, Edward E., city engineer of Cranston, R. I., died recently.

Miller, J. L., formerly successively county engineer of Ross county, and later city engineer of Chilicothe, Ohio, died Feb. 14.

Atkinson, Irving M., recently assistant division engineer, California State Highway Commission, died in San Francisco, March 1.

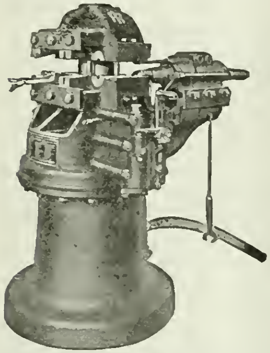
Strack, Thos. P., general contractor in municipal work, died recently in Cincinnati.

New Appliances

The New Drill Steel Sharpener.

A new compressed air operated drill steel sharpener machine known as the I-R No. 50 Sharpener has been developed by the Ingersoll-Rand Company. This sharpener was designed to sharpen and shank cruciform steel up to 2 in. diameter or round, hexagon, octagon, quarter-octagon, auger or spiral steel up to 1⅞ in. diameter. When fitted with special devices, it will forge boltheads, pins, stanchions, etc., nearly 200 different products having been made by it.

The single lever, which controls all of the operations of the machine, is fitted with a safety locking device. The throttle valve is of the balanced spool type, operates easily and quickly, is positive and instantaneous in its action.



DRILL STEEL SHARPENER OPERATED BY COMPRESSED AIR.

The hammer cylinder is an improved valveless type of hammer drill cylinder. This construction permits the free moving hammer to deliver fast and powerful blows with extreme rapidity.

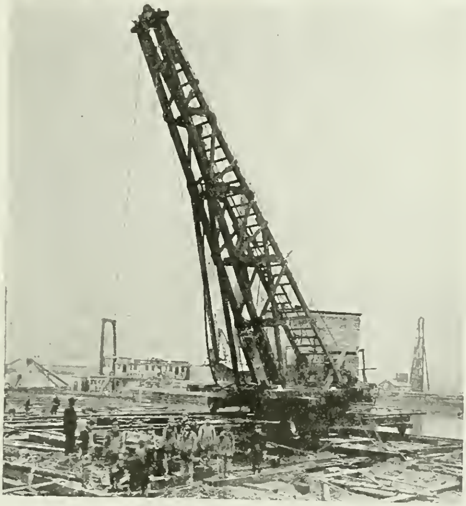
Solvay Graphite Paint.

This paint, manufactured by the Solvay Process Company, is especially recommended by them for bridges, corrugated iron buildings, and other metal structures, because, being made of amorphous graphite, refined pitch and vegetable oils, all of which are absolutely inert and resistent to atmospheric influences, it is a very durable covering for iron and steel. It is a black paint with a covering capacity of 550 square feet per gallon, and requires from 24 to 36 hours for drying.

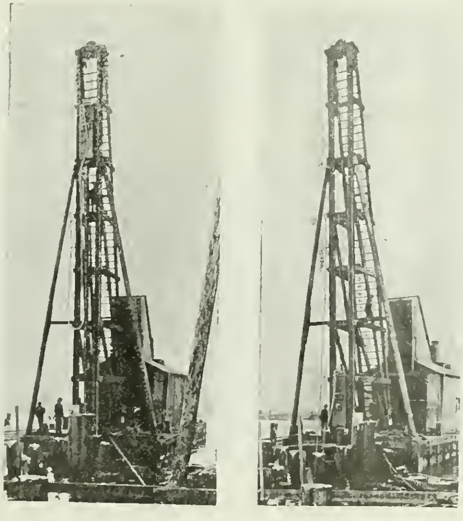
McKiernan-Terry Hammers.

McKiernan-Terry double-acting pile hammers are adapted for both driving and pulling wooden, concrete and steel foundation and sheet piles. They are made in several sizes for all kinds of work and give great efficiency, due to the powerful, rapid strokes that keep the pile in constant motion, reducing its friction to a minimum and preventing the weight of the pile from absorbing the driving force. The 11-B hammer, with 90 pounds steam pressure in cylinder, strikes 120 17,500-foot-pound blows per minute. One of these hammers installed in the tower of an ordinary floating machine drove 58-foot piles in 90 seconds each.

These double-acting hammers are especially useful for driving inclined piles, because the force is substantially independent of the position of the hammer or inclination of the ways, and they can



DOUBLE ACTING HAMMER DRIVING SPUR PILES.



BEFORE AND AFTER DRIVING A PILE 58 FEET IN 90 SECONDS.

easily be handled in tilted ways to drive spur piles that could hardly be installed with an ordinary drop hammer. They are manufactured and distributed by the McKiernan-Terry Drill Company, which also designs and supplies mining and quarrying machinery and lifting jacks. Bulletin 25, sent free on application, describes many difficult jobs successfully executed with these powerful hammers.

Republic Truck Wins as Fire Engine.

On January 13 at 54th St. Pier, New York City, a Republic truck, Model 19, 2½-ton chassis fitted with the Republic standard triple combination fire apparatus, successfully passed the fire truck test of the National Board of Fire Underwriters.

This test is usually held yearly and is so stiff that commercial truck manufacturers have largely passed it up.

The test on January 13 was a special one made at the request of the Republic Motor Truck Company.

The Republic truck actually pumped water continuously for 13½ hours, and at the conclusion of the test the official report says "the motor and pump at the end of the test were quiet, cool, in satisfactory condition, without vibration or pulsations."

The first test was completed in six hours and showed a new pump pressure of 120 pounds and an average motor speed of 1,350 r. p. m.

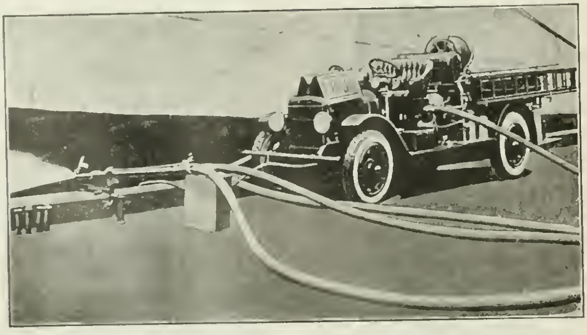
At the end of nine hours the second test was completed, the net pump pressure being 200 pounds at 1,625 r. p. m.—the pump being geared to the transmission at second speed.

The third test was completed with twelve hours of continuous running and showed a pump pressure of 250 pounds, at pumping capacity of one-third full capacity at 1,250 r. p. m.

For good measure, the pumping was continued an hour and a half after the completion of the tests.

The next day the first truck was given the road test of the board, which is extremely severe. A special course covering twenty miles is laid out, the pavement embracing macadam, asphalt and brick pavements in various conditions.

The Republic, loaded with 1,000 feet of regulation 2½-inch hose and eight men, a regular sized crew, made the trip in 50 minutes and 10 seconds. Further tests in hill climbing and descending were made and in every test the Republic made a perfect score.



AUTOMOBILE TRUCK PUMPS FIRE STREAM 13½ HOURS CONTINUOUSLY, MAINTAINING 250 POUNDS PRESSURE.

United Iron Works, Inc.

This company manufactures machinery for crushing rock and for screening, elevating and storing the product of those machines. The United crushers are made from heavy semi-steel castings and in eight sizes varying from 7x10 inches with a capacity of 6 tons per hour to 12x24 inches with 35 tons capacity. All parts are interchangeable and all machines are provided with a wedged bolt bracket designed to give way first should an unbreakable object get accidentally into the machine.

The machines are sold separately or mounted on a special heavy framed steel truck with a gooseneck bearing for the front axle, enabling it to turn within a small radius. The trucks may be equipped with a 14-inch conveyor belt mounted on pulleys 11 feet apart on centers and supported on a two-wheel truck attached to the crusher, thus permitting the stone to be delivered from the crusher at a height of 3½ to 6½ feet above the ground so as to load a wagon alongside, if desired. A folding bucket elevator that can be extended to a length of 17½ feet can be supplied enabling the product to be raised to an elevated storage bin.

Steel and wooden 15 and 30-yard storage bins with W-shape bottoms and three delivery chutes on each side can be furnished, provided with braced supports and with trucks for transportation. They may also be provided with revolving cylinder screens mounted on top. The company also furnishes crushing rollers for ordinary duty and for heavy duty in nine sizes running from 15x10 inches to 42x14 inches.

Crosby Clips.

Crosby clips, manufactured by the American Hoist & Derrick Company, are fasteners for securing wire rope. Each consists of a U-shape bolt with the ends passing through a malleable iron saddle with nuts bearing on the outside. Both parts of the rope being laid parallel and passed through and between the saddle and U-bolt, the latter is screwed tight and develops sufficient friction to prevent the parts of the rope moving on each other and thus secures the bight or splice. One to four clips well adjusted make a quick and reliable fastening that develops the strength of the rope and requires littles or no subsequent attention. It is very suitable for tackles, guy ropes and other purposes.

An unusual example was afforded by the construction of a 180-foot-span suspended-platform, used for taking a 70-ton dragline excavator across the shallow channel of the Rio Grande River for reclamation work. Piles were driven 25 feet apart on opposite sides of the river and between them were stretched ¾-inch steel cables adjusted by tackles and anchored upstream. To these horizontal cables were attached by U-bolts, a floor of transverse 6x16-inch beams 20 feet long and 6 inches apart in the clear. These beams normally floated on the surface of the water and were maintained in approximate position by the cables, secured by the Crosby clips while the dragline excavator crossed the river on them under its own caterpillar traction power. Each end of each main cable was secured by a loop engaging the pile and fastened by three Crosby clips.

The United States Government has recently ordered a $605,000 10-yard dipper dredge from Secor R. Browning, Cleveland.

French Standard Specifications on Various Materials.

Trade commissioner H. W. Adams, of Paris, has transmitted copies of the French standard specifications on various materials, gotten out by the Commission Permanente de Standardization of the Ministry of Commerce. These pamphlets may be examined at the Bureau of Foreign and Domestic Commerce by referring to file No. 21289.

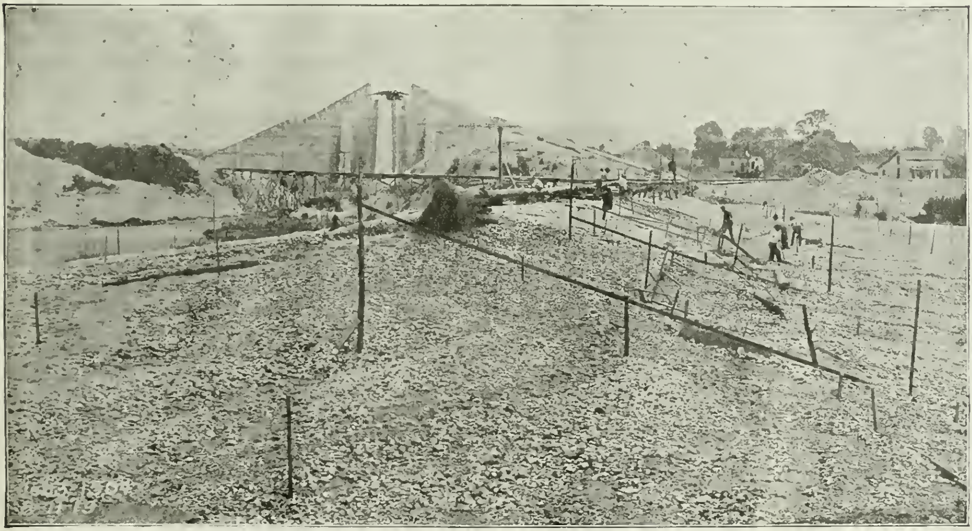
PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"
Vol. 48 NEW YORK, MAY 8, 1920 No. 17

Hydraulic Fill Dams for Miami Conservancy District

Five earth dams in the $25,000,000 improvement are being made with core embankments built up between side slopes enclosed by parallel levees, all made of materials excavated by dragline machines, hauled in dump cars, pumped to site and deposited by hydraulic operations. Great progress in design, methods and plant secure advanced methods of construction, remarkable for rapidity and economy.

A general description of the work being done by the Miami Conservancy District and the reason therefor was given in the February 14 issue of *Public Works,* and in that of February 21 was described the use of drag-line excavators in removing rock excavation. In this article will be described the construction of the five dams by the hydraulic fill method. The work is under the direction of Arthur E. Morgan, chief engineer, Charles H. Paul, assistant engineer, and C. H. Locher, construction manager.

At first the project was classified and divided into



BUILDING THE SOUTH BEACH AND DAM SLOPE, LOCKINGTON DAM.
The slanting boards indicate the finished slope of the dam embankment, the men raking and shovelling the sand and gravel flush with the lower edges. The embankment will be carried up to the top of the wall seen in the background.

about 100 principal contracts, but on account of war conditions and the state of the labor and material markets and for other reasons, few satisfactory bids were received and most of the work has been done by district forces with a very carefully designed system of standard and specially selected mechanical equipment, mostly electrical, which has involved the expenditure of over $2,000,000, exclusive of materials, supplies and the construction of numerous camps for the accommodation of workmen in places remote from large cities.

MAGNITUDE AND CHARACTER OF DAMS.

The five dams involve for their construction 12,000,000 yards of earth excavation and 200,000 yards of concreting. The Englewood dam is the largest, with a length of 4,660 feet, a height of 108 feet from bed of river to crest of spillway, and a volume of 4,000,000 yards of earth and 38,000 yards of concrete. The smallest dam is that at Germantown, which has a volume of only 865,000 yards of earth.

Each dam extends across the full width of its valley, is built on the prepared surface of the ground, and consists of wide embankments of selected materials with flat paved slopes of 2, 2½, 3 and 4 on 1, counting from top to bottom, and separated with berms and drainage ditches and 10 on 1 apron slopes at the toes.

The center part of the dam is an impervious core of fine material solidly packed and extended down into a core trench of sufficient depth to insure against seepage and undermining. This longitudinal core is supported on both sides by shoulders of sand and gravel, making a stable gravity section. The shoulders on both up and downstream faces of the dam are well covered with a thick layer of coarse gravel and boulders equivalent to a heavy pavement covered with top soil. The crest of the dam is occupied by reinforced concrete roadways 25 feet wide reaching across the valley from side to side.

The concrete conduits, some of which are open canals and some of which are covered, making them essentially culverts, have an unrestricted capacity equal to that of the stream below. When this flow is exceeded the water backs up above the dam until the quantity impounded is 40 per cent greater than that of the 1913 flood, when it can safely escape over concrete spillways.

GENERAL CONSTRUCTION FEATURES.

The hydraulic fill method in its simplest form consists in the use of pumps for lifting, conveying and depositing solid matter suspended in water. This is frequently accomplished by suction dredges which excavate soft bottom and discharge through long pipes to fill in adjacent low ground. In the west, where heavy hydraulic pressure is frequently used, powerful jets are employed to wash down and undermine earth, gravel and other materials and to wash them into sluices, flumes or pipes through which they are transported by gravity to the required position and there deposited by the water flowing over the surface of the fill.

In the Miami dam construction these methods have been combined, modified and supplemented by other features, and have been developed in a rational manner to utilize different standard and special equipment for the construction of an improved type of dam with the maximum utilization of local conditions and materials.

The principal operations are the preparation of the foundation and the cut-off trench; the building of the upstream and downstream faces or slopes of the dam of boulders, coarse materials and sand and gravel used to form successive tiers of levees; the simultaneous construction, at a fixed rate behind the levee construction, of flat inner slopes of sand and gravel forming the thick sides of a full-length longitudinal settling trough or pool, built up in horizontal layers corresponding to those of the outer levees; and the construction, submerged in the pool, also in successive and simultaneous horizontal layers, of the impervious center core that fills the trough and forms the heart of the dam.

All of the materials for the embankment are provided by mechanical excavation at borrow pits, usually by drag-line machines, delivered to dump cars, hauled by locomotives and emptied into special sumps where they are more or less mixed and controlled and whence they are pumped by powerful centrifugal dredge machines which deliver them a maximum distance of several thousand feet horizontally and a few hundred feet vertically, to the required position at the dam site. Here, by proper manipulations, the water, discharging into the interior trough, automatically separates the classified material and deposits it as required to make the outer slopes, the shoulders and the core, which are deposited in uniform layers from end to end across the valley and back again until the dam is built to the required height. The outer slopes, requiring some hand and machine work, are built first and are rapidly constructed, subsequently the material deposited next to them by hydraulic action rapidly fills up the shoulders by forming "Beaches," which are the sides of the trough, in which trough the fine material is more slowly deposited, wholly by sedimentation, to form the impervious core, completing the structure. Accurate control of the process, definite results and exact proportion of the different parts of the cross-section are secured by experienced control of the pumps, the relative elevations of delivery and outlet for the water and by the character and proportions of the materials secured from the borrow pits.

PRELIMINARY OPERATIONS.

The clearing and grubbing of the site is followed by the removal of the top soil with ploughs, wheeled scrapers, dump wagons, and elevating graders. The earth thus removed is deposited in spoil banks beyond the upstream and downstream toes, and stored for use as a top dressing on the finished slopes.

After the site has been stripped, a cut-off trench about 30 feet deep and 50 feet wide is excavated from end to end of the axis of the dam by a drag-line machine. Steel sheeting to cut off leaks is driven when necessary and the trench is filled with puddled clay.

Wherever necessary, by-passes are excavated to carry the stream flow across the dam until the permanent concrete conduits have been constructed, and the materials derived from these excavations, from borrow pits or from any other suitable source, are used for the construction, by hand or by machines, of levees from 4 to 8 feet high parallel with the axis of the dam, which are located at the up and down-stream toes of the embankment and reach across the valley from side to side, enclosing between them and the side slopes of the valley a rectangular area embracing the whole foundation of the dam.

Adjacent to these levees and a little beyond them is excavated, on each side of the large dams, a sump, called a "hog box," usually from 10 to 20 feet wide and deep and about 100 feet long, with the sides sheeted or braced if necessary.

As the spoil banks are built up, they are continuously washed down into the sumps by powerful hydraulic jets from monitors, which are very carefully manipulated to provide to the pump suctions a constant supply and of as uniform a character as possible.

ENGLEWOOD EXCAVATION.

Although the details of excavation and transportation of the dam material vary at the different sites, the general features correspond and a good idea is given by the conditions existing at Englewood, where the 4,000,000 yards of earth for the embankment is excavated from an area on both sides of the river a little more than a mile long and a mile wide, which is adjacent to the dam on the upstream side.

This excavation is done by two 115-ton drag-line machines with 85-foot booms and 1½-yard buckets, which are installed about 1,000 feet apart on the same track. One of the machines, operated by electricity at 1.06c. per kilowatt hour, is a little slower than the steam machine but is somewhat less expensive on account of the high cost of coaling. The machines work on a face about 15 feet high and each, during a 10-hour shift, delivers from 150 to 180 cubic yards of earth, sand and gravel to the 12-yard air dump cars operating on a double-track system with cross-overs arranged for continuous movement of the cars without waiting.

The cars are run in four 7-car trains, each hauled by a 40-ton locomotive and up a 2 per cent grade to a dumping trestle 175 feet long and 13 feet above the floor of the hog box, which slopes about 4 per cent to an opening on the side.

DELIVERING MATERIAL TO THE PUMP SUCTION.

From the dump the material is sluiced into the hog box by a 60-pound hydraulic jet from the 3-inch nozzle of a monitor, the water for which is supplied by two 10-inch centrifugal pumps making 1,760 r. p. m. and each driven by a 100 horse-power motor.

The two monitors wash the materials to the opening in the floor of the hog box, through which it is discharged into revolving steel screens 4 feet in diameter and 9 feet long pierced with 6-inch and with 6½ inch holes through which the material passes to the 8x16 foot concrete sump having two 8x8-foot chambers with their bottoms 16 feet below the hog box. The axes of the screens are inclined 1:24 from the horizontal and are driven by 7½ h. p. electric motors at 9 and 14 r. p. m.

BEACH AND SLOPE AT EDGE OF POOL, ENGLEWOOD DAM.

Shows the sharp drop in the slope of the sand and gravel at the edge of the pool, which is normally at the top of the steep slope in the foreground, the pool water having been drawn down about 2 feet.

The materials rejected by the screens pass out of their lower ends and are loaded by derricks into cars, in which they are hauled to the downstream slope of the dam, where they are built into the levees. The material passing to the sump is used for the hydraulic fill. The revolving screens serve a double purpose, that of removing over-size stones, and that of regulating the feet to the suction so as to produce a uniform flow, which it was found impossible to accomplish without them when the material was moved up to the sump by the action of the hydraulic monitors alone. No matter how skillfully the monitors were handled, they would sometimes deliver almost clear water and at other times would deliver too large masses of solid material, thus making the action of the pumps very irregular and expensive and increasing the danger of the discharge pipe being plugged.

Under each screen is a hopper receiving the accepted material and mixing it as it passes to the suctions of the two 15-inch centrifugal pumps, each operated at 505 revolutions per minute by a direct-connected 500 h. p. variable slip-ring induction motor capable of delivering the flow at an elevation of 150 feet above the pumps. The pumps are provided with runners 38 inches to 46 inches in diameter to correspond with the different heads of 25 feet to 150 feet to which the effluent is raised.

Although made of manganese steel, the life of these pumps, when handling sand and gravel, is a little less than 200,000 cubic yards. The impellers show wear at 50,000 cubic yards but can be used to a maximum of about 100,000 cubic yards.

The dredge and monitor pumps together require about 31 cubic feet of water per second, which is derived by gravity from the river through a 4-ft. corrugated iron culvert. Each monitor uses about 2,000 gallons per minute and each dredge pumps about 7,000 gallons per minute.

PIPE LINE.

The dredge pumps discharge through a line of 15-inch cast-iron flanged pipe extending to the foot of the dam and remaining permanently in position. From the end of the cast-iron pipe, the discharge is continued through a movable extension of the line made up of light pieces, easily attached, detached and handled. At first these pipes were made of ordinary riveted steel construction, but this proved very short lived, and was later replaced by specially manufactured high-carbon-manganese steel 11-64 inch thick and weighing 28.83 pounds per linear foot. The pipes are made in 16-foot lengths with telescopic joints held in position with wire lashings around lugs on the ends of the welded pipe.

As it has been observed that all of the solids carried by the water are located in the lower third of the pipe, the circumference of the pipe is divided into three equal portions numbered at the ends, 1, 2, and 3, and whenever the pipe is shifted, care is taken to turn all of the sections uniformly 120 degrees in the same direction, thus insuring equal wear over the entire surface of the pipe, which so far has passed 300,000 yards of earth, sand and gravel without showing signs of failure.

EFFICIENCY OF PUMPING.

The greatest efficiency and economy of pumping is, of course, attained when the pumps work uniformly and continuously at full capacity. If too little solid matter is carried in suspension, money and time are of course wasted, and although the pumps can carry an overload for a short time, if it is long continued the pipe is inevitably plugged and much time, expense and discomfort are necessary to clean it out. Thorough co-ordination is therefore required between the monitor men at the hog box and the pump runner, and if the latter does not increase the power simultaneously and correspondingly when the material is crowded by the monitor, trouble is certain to result.

At first a control tower was built overlooking the hog box and in it were installed pressure and vacuum gages, electric bell connections to pump men and monitor men and connections with telephones at the ends of the pipe lines, thus enabling the signal man to direct the monitor men and the pump men; but it was found that the gages did not always operate as positively or as rapidly as necessary and the line would sometimes become plugged without warning.

As the first indication of plugging has been observed to be a decrease in the discharge at the end of the pipe, a float at that point is now arranged to maintain an electric contact when the discharge is maximum and any diminution of discharge breaks the contact and signals through electric lamps at each monitor and at the pump, thus enabling the proper steps to be taken instantly to prevent the plugging. The operation of this device has considerably increased the output and reduced the difficulty from plugging.

The percentage of solid matter handled by the pump varies up to 20 per cent of the volume of water, with a present average between 6 and 10 per cent. Where the material is of a clayey nature as at Taylorville, with a discharge velocity of 12 feet per second the frictional loss of head is about 4 feet in 100 linear feet, but in gritty sands and gravels at Englewood and Germantown, with velocities of 12 feet and upwards the friction head amounts to as much as 8 feet per 100.

At Englewood, the monthly delivery of two 15-inch dredge pumps, each working two 10-hour shifts a day, averaged 85,000 yards until changes and improvements in the screens and sumps increased it last fall to 150 yards per hour for each pump or 6,000 yards per day.

(To be concluded)

Virginia Issues Engineers' Certificates

The engineers' license bill has been passed by the Virginia legislature, signed by the governor and is now a law. It provides for the issuing of certificates to practice under the title of certified professional engineer, or certified architect, or certified land surveyor.

The examining board is composed of three architects, three professional engineers and three land surveyors, with at least ten years' engineering experience. Certificates are granted upon evidence that the applicant has practiced engineering or architecture for not less than six years or land surveying for not less than two years The fee is $5.00.

Any citizen in the United States or any citizen-declarant of twenty-one years of age, of good character with at least four years' experience in engineering or architecture, or two years' experience in land surveying, or who is a graduate in architecture or engineering may be granted a certificate after satisfactorily passing the examination in such professional subjects as may be prescribed by the board. The bill provides for reciprocity with other states whose requirements are satisfactory to the board.

Rainfall Records at Hartford

Continuous records of from seven years to sixty years' duration contain data tending to show that the precipitation of three to six months only determines whether that for the year is excessive or deficient.

The annual report of the Board of Water Commissioners of Hartford, Conn., for the year ending March 1, 1919, contains rainfall records on the several water-sheds of the water department, one of them running back 60 years, another 51 years and three others for seven years. These show the rainfall for each month of the year 1918, of the year of maximum rainfall, of minimum rainfall and the average rainfall for each of the months. They show some interesting facts concerning years of exceptional rainfall which, while not developing any new ideas, are interesting as supplementing other similar records.

One of the most striking features about these figures is that it is the rainfall of two, three or four months of a year which determines whether it is a year of maximum or of minimum rainfall. For instance, taking the 51-year record at West Hartford reservoir, we find that during the year of maximum rainfall the monthly rainfall was less than the monthly average for the 51 years during 6 months, namely January, February, June, July, October and November. The great excess occurred in the months of March, April, May and December. On the other hand, during the year of minimum rainfall, the monthly rainfall during February and October was greater than the average.

Taking the 60-year record, we find in the same way that during the maximum year the monthly rainfall was less than the average for that month during January, April, July and August, while the months of heavier rainfall were May, June and October. It will be noted that two of these months of excessive rainfall were the same as those of deficient rainfall during the maximum year of the other record, while one of the months of deficient rainfall of the 60-year record was a month of maximum rainfall of the 51-year record. In this series of records, also, the minimum year contained three months during which the rainfall exceeded the monthly average, these being August, September and November. Incidentally, this record contains the only month of absolute lack of precipitation shown in any of the eight records given, this being in January.

The seven-year records show similar peculiarities. One of these is that on the Nepaug basin, the year of minimum rainfall having a rainfall of 4.65 inches in March, while during the same month in the year of maximum rainfall the precipitation was only 0.06; and for April the minimum year gave a rainfall of 4.42 inches and the maximum year only 2.07 inches. June and October also showed the record of the minimum year exceeding that of the maximum year, although by considerably less amounts. In fact, six of the twelve months show higher monthly rainfall during the minimum year than during corresponding months of the maximum year.

The conclusion suggested (although, of course, by no means proved) by these figures is that annual records of excessive or deficient rainfall are occasioned by unusual precipitation during only three to six months of the year and not by conditions continuing throughout the year.

Cleaning New York Streets

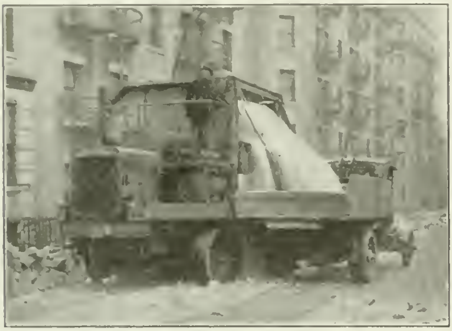
Recommendation of use of alternate machine sweeping and flushing, and use of motor equipment for snow removal.

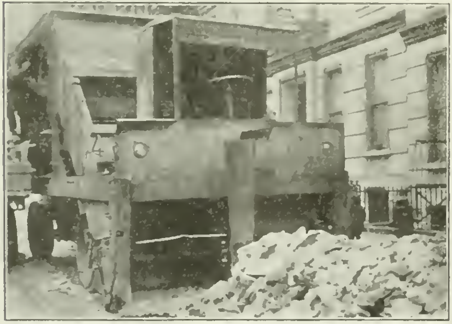
Methods and equipment, and their efficiency, for removing snow, ashes and garbage from the streets of New York are discussed in the April 12 issue of a leaflet entitled "Women and the City's Work" which is published by the Women's Municipal League of the city of New York. This recommends that the system of former street cleaning commissioner Fetherston, namely, cleaning the streets with sweeping machines one night and flushing them the next night, be extended to cover the entire city and that the sweeping machines be followed up by vacuum cleaners instead of by hand work. This system to be maintained during nine months in the year, omitting the flushing in freezing weather.

The snowfalls should be swept up and brushed to the center of the road bed and then handled by automobile machines making one trip down the center of the street, elevating the material and loading it into trucks, thus greatly expediting the work and diminishing the number of men required. It is recommended that the snow removing machine should also be equipped with a vacuum cleaner to carry the dirt up into the hopper at the top and empty it, so that it may be used in the summer for handling dirt, ashes and garbage, which should be emptied into the same trucks used for transporting snow in winter. These snow trucks would only need the addition of a cover to prevent the ashes from blowing away.

These machines should be motor drawn and should be stored in garages so as to protect them from the weather to which, at the present time, the street cleaning machinery is said to be exposed. The Board of Estimate and Apportionment is therefore petitioned to immediately appropriate money for building garages and shelters throughout the city to house the automobile trucks and machines.

The statement is made that a year ago when the city forces were used to dispose of ashes for filling in at Rikers Island, they were able to dispose of only four scow loads per day, while the contractor who afterwards undertook this work disposed of eight scow loads per day. The contract, however, expired on the first of April and the city will be obliged either to buy additional equipment or find some other disposition for the ashes which can well be applied to filling in many marshy places in and around New York which can be reclaimed for business purposes and dwellings.


TANK MACHINE ELEVATING AND LOADING SNOW.


DUPLEX ELEVATOR SHOVELS OF TANK MACHINE.

SNOW TANK MACHINE IN NEW YORK STREET.

It is represented that the removal of New York garbage is even less satisfactory than the ash removal; that the garbage is sometimes mixed with ashes which, when used in fill, constitute a menace to public health, and it is suggested that the garbage disposal plant now installed on Staten Island be removed and used to equip several small plants in the different boroughs, thus eliminating expensive long hauls and reclaiming by-products, besides dispensing with the private ash collectors, to whom no future licenses should be issued.

It is stated that the cost of handling snow in New York streets last winter was $6,000,000, a large portion of which could be saved by the operation of an adequate system of snow-handling machinery, the installation of which could be largely provided for by this economy, to say nothing of the immense losses that the heavy snowfall and its slow removal have occasioned by damage to automobiles and trucks and the loss of perishable freight which could not be delivered on account of the conditions of the streets.

Mechanical Snow and Ice Removal

During last winter successful demonstrations were made in the streets of New York City, of the operation, by two men, of a machine handling snow at the rate of 50 cubic yards per minute or ice at the rate of 25 yards per minute, clearing a path 9½ feet wide at the rate of 8 miles per hour for a six-inch snowfall and delivering the snow or ice continuously to trucks or cars alongside or depositing it in piles, thus eliminating a large amount of hand labor and providing for a rapid opening of street for traffic obstructed by snow.

The machine, called a Friedman snow tank, is 26 feet long, 9½ feet wide and 12½ feet high, weighing 22 tons. It has a steel frame tank mounted on a Christie four-wheel drive truck with a special frame. Over the rear wheels of the truck is mounted a 150 h. p. 6 cylinder Sterling marine engine 5½-inch bore and 6¾-inch stroke which is started electrically from the rear platform. This engine operates an inclined conveyor having two parallel sets of steel buckets with heavy cutting edges mounted on endless chains and acting as shovels that cut and scoop up the snow and ice and elevate them, in a closed box, to the receiving hopper as the machine advances under its own power like an ordinary automobile truck. The contents of the hopper can be discharged continuously, clear of one side of the machine by a transverse conveyor thus forming a bank alongside the cleared space, or it can be discharged intermittently by opening the side door in the hopper and operating a lever that empties the contents in a separate heap on the ground or delivers it to the car or truck alongside. When not excavating, the machine has a maximum speed of 10 miles per hour, with four speeds ahead and one speed reverse. It can excavate at the rate of 8 miles per hour in snow 6 inches deep to 2 miles an hour in snow 24 inches deep, loading flat cars at the rate of 25 to 50 yards per hour according to the consistency of the material handled. An 8-yard truck can be loaded in from 1 to 1½ minutes.

The machine can be operated continuously day and night except for a reasonable allowance of say 2 hours per diem for oiling, cleaning, fuel supply, change of shifts, etc., thus affording 22 working hours in which time it is capable of loading 1,300 8-yard trucks. It is operated by two men, the truck driver and the mechanic who stands on the rear platform and operates the motor underneath and the levers controlling the loading slide. In a speed demonstration, held Friday, March 19, for the New York City authorities, four 5-ton trucks were filled with ice in less than 3 minutes.

Allowing an extra man, three in all, for the operation of the machine and assuming it to require 5 gallons of gas and oil per hour with $25 per day for wear and tear and $50 per day for overhead, the total cost of excavating and loading at the rate of one truck load per minute is $0.20 as compared with $2.66 for loading with an 8-men gang in 20 minutes. Adding to this $1 for the average cost of an auto truck carting the snow and returning in 15 minutes, the cost of the machine work is $1.20 and by hand is $3.66. The total cost to the city allowing for expansion of snow in the trucks, and for piling, loading and carting, is estimated at $6.12 for 8 cubic yards for hand work while the corresponding cost for machine work is only 64 cents, thus effecting, according to the promoter's figures, a saving of $5.48 for large truck loads or about $0.68 per yard of snow and ice. They also estimate that a fleet of 50 of these machines would clean the streets of New York in from one to three days, depending on the size of the snowfall, provided sufficient facilities were furnished for removing the snow which would require a large number of automobile trucks systematically operated to be in constant attendance on each machine and to move uninterrupted back and forth between it and the dumping grounds.

The Alien Labor Supply

Immigration in 1919 was less than one-seventh what it was in 1913, while emigration has greatly increased. The shortage is especially felt in the necessary uses of common and farm labor. Abundance of such labor will probably come if not discouraged.

For the last few years the United States has been depending to an increasing extent on aliens for a large proportion of its labor, amounting, for unskilled work, to nearly the whole supply and to half or more for many important branches of skilled work such as steel making, carpenters, masons and the like. The supply was not only greatly diminished, and in some cases almost entirely cut off, by the breaking out of the war, but many of the aliens already here left their occupations to return at the earliest moment for war service in their native country.

As shown by the accompanying table prepared from the United States Records, immigration was less than 15 per cent as much in 1919 as it was in 1913, while emigration in 1918 was more than 316 per cent of what it was in 1913, and in December, 1919, the arrival of aliens was only about 40 per cent of what it was in December, 1913:

About 85 per cent of the immigrants to this country arrive at the port of New York, where at the present time it is estimated about 80 per cent of them are reservists, that is, men of military age that are required to respond on call to the demands of their native country for military service.

Total Number of Steerage Aliens, Including Women and Children, Entering and Leaving United States from 1913-1918.

Year	Immigrants	Emigrants
1913	1,142,227	611,924
1914	1,403,081	633,805
1915	434,244	384,174
1916	366,748	240,807
1917	362,877	146,374
1918	211,853	193,268

Alien Arrivals in 1919.

Month	Immigrants
January	2,589
February	2,975
March	5,850
April	11,355
May	7,462
June	9,485
July	9,439
August	9,430
September	20,577
October	24,641
November	17,557
December	34,529
December, 1913	78,977

Among the different nations represented in the arrivals, the Italians predominate, and after them Poles and Czecho-Slavs. It is reported that at least 100,000 Italians are awaiting an opportunity to emigrate to this country and that large numbers of citizens of other European countries would gladly come here were it not for restrictions that they cannot overcome. Official admissions have not been made that they are subject to government restrictions, but there is good reason to believe that if passports, and their visé by American officials, were easy and simple to get and transportation was abundant, very large quantities of laborers would pour into this country and most of them would be desirable additions for our industrial work.

Classified statistics of the proportion of able-bodied male laborers to the total number of immigrants or of the work for which they are qualified or of their distribution in this country are not accessible, if indeed they exist, but it is in general true that they pass through the ports of entry in groups as arranged for by European agents and bound for more or less remote localities or that they come to join friends and relatives already settled all over the country. There is no clearing house for the classification and distribution of foreign labor and it is not under much rational direction.

Careful observation of the arrivals at Ellis Island indicates that a very large percentage of them are desirable laborers and that the proportion of anarchists, bolshevists and other dangerous radicals is small and would be much less mischievous if promptly dealt with in accordance with their actions and deprived of all newspaper publicity. After the arrival of immigrants in this country, it is difficult to commence investigations concerning them, which should be carefully attended to by qualified officials in their home countries, which should rigidly exclude undesirables.

Conditions in European countries are and will be so difficult that there will be an enormous number of emigrants ready to come here as soon as they are able to do so and as long as attractive conditions exist in this country.

It is significant, also, that the shortage of both foreign and native labor is most severely felt in work connected with the necessities of life, while the manufacturers of luxuries, mostly requiring lighter and pleasanter work, have abundance of labor to whom they practically pay any price demanded and simply charge the excess to the public, which in this era of extravagance pays most exorbitantly without protest. This condition may be overcome in a measure by making conditions of work more attractive and by employing a higher class of labor.

Advertising for Labor

The scarcity of labor and the failure of adequate supply from ordinary channels has caused some large employers to make special efforts through recruiting officials and public advertisements. The latter usually appear in local papers published in districts where there is reason to look for an excess of men, a scarcity of employment or an unbalanced condition. This practice has been extended in a recent case to the publication, in a technical paper principally read by employers, dealers and officials rather than by individual workmen, of a conspicuous announcement giving particulars of the job, conditions of work and provisions for the welfare of the men, which are naturally made as attractive as possible with an appeal for more than 300 skilled workmen on a 5-year contract at wages ranging from 50 to 75 cents per hour.

The advertisement describes the housing conditions offered, including a private room with single beds and 400 cubic feet of air space for each man, a recreation room for every 28 men, improved sanitary arrangement and high-class board and lodging at a cost of not more than $7 per week. One thousand men will be needed to complete the job.

Massachusetts Educating Immigrants

The Intelligence Department of the State of Massachusetts has commenced an active campaign among industrial workers with a view to inspiring patriotism and loyalty and educating foreigners in political and industrial matters. Little books are to be issued giving alphabetical and geographical lists of the industries of the state, together with information concerning the cities and towns where they are located and explaining their educational and recreational advantages and other attractions They will also give descriptions of the holidays and of their meaning, an example of which is afforded by the reference to April 19, 1775, the anniversary of which has been set apart to commemorate the first battle of a nation determined to be governed by law instead of the arbitrary will of a despot, since when America has always stood for law and for order under the rule of a government chosen by the people themselves with no distinction of class, wealth or creed.

Decisions of National War Labor Board

In the case of the Pacific Electric Railway Company, Los Angeles, California, the National War Labor Board finds that the employes' individual discussion of grievances without a system of collective bargaining is inadequate and recommends that the employes be given the right to meet and treat, through their own committees, with the officials of the company in regard to wages, working conditions and other matters and that these committees should be recognized regardless of the fact that the individuals are members of the union. This does not, however, imply that the company deals with or recognizes the union but merely that it deals with the committees of employes and not with the union.

In the case of individual workers at Lancaster, Pennsylvania, the board rules that because of depression, hours should be reduced before men are laid off.

In the case of the Schuykill Railway Company and its employes, the Board rules that the contract fixing the wages until a specified future date could not be annulled without the consent of the employers.

In another case it denied an advance of wages to teamsters in Lynn, Massachusetts, on the ground that there had not been a material change in the cost of living since the agreement last made and that what change is now taking place is rather in the direction of lower prices.

Labor Notes

Some recent happenings and reports which have a bearing upon the subject of the labor supply available in the United States.

The number of employes in New York State factories in July, 1918, was 25 per cent, and in February, 1919, was 11 per cent more than in June, 1918.

Legislation is proposed in Sweden to standardize an 8-hour working day for all classes of labor. Manufacturers claim that with present wages this will make production impossible and shoe manufacturers have already decided to close down plants and it is anticipated that hundreds of the thousands of workmen may be thrown of employment if the law is passed.

The Trades Hall Council of Melbourne is agitating for the adoption of a 40-hour week for all workers in all industries in Australia.

It is reported that five meat packing companies of Chicago have given a pledge to Secretary of Labor Wilson that they will make no wage reduction for at least one year after the signing of peace, and that they will guarantee a 44-hour week with time-and-a-half for work over 8 hours and double time for Sundays and holidays, the present wage scale running from 46½ cents per hour for common labor to $1.25 for skilled labor.

A plan has been adopted at the Standard Steel Car Works, Hammon, Indiana, whereby workmen committees, in conference with the owners' committees, will take up the subjects of shop methods and economy, employment and working conditions, housing and living conditions, athletics, recreation and education.

American Inland Waterways

Speakers at the convention of the Mississippi Valley Waterways Association at St. Louis urged that the country develop its inland waterways transportation in order to retain its position in the world of commerce.

James E. Smith, president of the association, compared America with Europe fifty years ago when that continent discovered the necessity of using waterways as carriers and built artificial channels. He declared that America had the natural channels but did not appreciate their value.

Brigadier General Hines, chief of transportation of the War Department, said that the railroads welcomed the revival of water transportation as "a necessary ally in the solution of transportation problems." He further stated that the War Department desired to become a material factor in assisting waterways to assume a considerable portion of the transportation problems and cited the operation of several barge services already initiated as a single but vital phase of this undertaking.

Surveys are now being made for a 59 mile canal from Jatineo, Glenn County, to Williams Road, Colusa County, California, for the irrigation of 250,000 acres of rice lands. Plans are to be filed with the State Reclamation Board and it is intended to execute the work as rapidly as possible.

The Transportation Situation

At the luncheon meeting of Members' Council of the Merchants' Association of New York, held April 19, the transportation situation was discussed before more than 1,000 members and guests largely representing important business interests. In discussing transportation conditions and their influence on general business, A. H. Smith, president of the New York Central lines, said, regarding the "outlaw" strike, that it is a proof of morale because of the loyalty of the majority of railroad employes, who are fundamentally sound and are proving their worth as good Americans despite the disturbances of the few hotheads that have gotten away, and that we should take courage and hope from the present experiences.

Mr. Smith referred to the tremendous handicap placed on the railroads by legislating an enormous increase of payroll without permitting an increase of rates, and to the depreciation and shortage of equipment during government control, notwithstanding which the Central Railroad has just authorized the purchase of $50,000,000 worth of new equipment on account of the 10,000 passenger cars and 2,000 locomotives now lacking. He stated that the railroad situation on Manhattan Island is practically what it was 30 years ago and that at least $200,000 a day is wasted there in distribution. He also stated that the average cost of all the railroads in the United States, including their equipment, is only $72,000 a mile, while a highway across the state of New York cost $36,000 per mile.

George C. Taylor, president of the American Railway Express Company (the new corporation which purchased the property of the Adams, American, Southern, and Wells Fargo Express Companies), stated that they have operated for 22 months without any return for the $35,000,000 value of their real estate and plant and with a deficit of more than $33,000,000, and said that their efforts are now centered on giving better service by the use of the most direct routes, avoiding duplicate service and expense, avoiding delay and damage by rehandling at junction points and transfers, and competing fairly with parcel post, normal freight service and trucking service. The organization of more than 135,000 people in 35,000 offices has an annual turnover of about $300,000,000 of charges and asks only for a fighting chance to give efficient, cooperative and dependable fast transportation service.

The veteran railroader, Chauncey M. Depew, said that for the first time in fifty years the public is beginning to look at the railways as a partner with whom there should be no controversy. Referring to the relations between railroads and labor unions, Mr. Depew said: "I have been dealing with unions all my life. I never had any trouble with them. I believe in them. You can get down to a fair, square, man-to-man talk with them, as to what is needed on the one side, on the other, and on all sides. But there is one thing that must not be forgotten, and that is that no section, no class, no occupation, should be able to prevent the people in other occupations from exercising their functions; and the only way to stop that is to have a new union, a new union of the middle-class men of this country and the middle class women of this country, who constitute eighty or ninety per cent of our population, and let them form a union which shall declare that all classes must be treated fairly, squarely, rightly, justly and righteously!"

Tunnels and Canals

An unsuccessful effort was recently made by Senators Edge and Calder, of New York, to have Congress include in the Urgent Deficiency bill an appropriation of $100,000 for the federal investigation of methods of ventilating vehicular tunnels to be conducted by the Bureau of Mines and secure information of great value for the solution of the problem of ventilating the proposed New York, New Jersey and other vehicular tunnels and similar projects.

Proposals for bond issues to be submitted to taxpayers of New Jersey this year total $57,000,000. The items in this proposed bond budget include $28,000,000 for interstate bridge and tunnel, $1,000,000 for the trans-state ship canal right of way and $16,000,000 to provide for the construction and enlargement of institutions.

Frank M. Williams, state engineer of New York, has reported to the Legislature condemning, as unfeasible, the proposed St. Lawrence canal for a direct ship route from the Great Lakes to Europe.

To Dam the Grand Canyon

It is planned to dam the Grand Canyon in order to supply electricity for the entire state of Arizona. The plan, which has just been revealed by Ralph Cameron, builder of the scenic Bright Angel trail, calls for a dam 400 feet high and 600 feet across the top, creating a water head that will distribute 1,000,000 horse-power of electric energy throughout the state. The plan is backed by $100,000,000 of New York capital.

Power from this source will be delivered to practically every farm, mine and industrial plant in the state at a price of one cent per kilowat instead of ten cents as is now the case. The dam, when completed, will impound water sufficient to make a lake 23 miles long.

Hetch-Hetchy Tunnel Contract

On April 27 the city of San Francisco received four bids for the construction of about 16 miles of aqueduct in tunnel through the Sierra Nevada mountains, the lowest bids being $7,802,952 on the cost-plus-fee basis and about $10,000,000 on the unit price basis. The lowest bidder was the Construction Company of North America whose fee of $1,190,329 was based on estimated costs of $78, $84 and $83 per linear foot for the three divisions of the tunnel. The lowest bidder on the unit price basis was R. C. Storrie & Company whose total bid of about $10,000,000 was based on estimates of $107, $105 and $109 per linear foot for the three divisions.

The city of San Francisco will issue from $12,000,000 to $15,000,000 of bonds to pay for the work, and if the contract is awarded on the cost-plus basis, the bonds will be purchased for cash by the banks at par, and out of the contractor's fee the contractor will immediately pay back $260,000 to the bank, and afterwards three successive payments which together will make up the difference between the market price of the bonds and the par value which the banks advance.

If the contract is awarded on the unit price basis, the contractor himself will accept the bonds at par, assume all costs of construction, and deposit a certified check for 10 per cent of the estimated cost of the work, as guarantee for its satisfactory construction, and will make his profit, if any, on the difference between the selling price of the bonds and the actual cost of the work.

Fellowships in Highway Engineering and Transport

The University of Michigan offers four fellowships during the collegiate year, 1920-1921, as follows:

The Roy D. Chapin fellowship in highway transport, for investigation of an approved subject relative to highway transport.

The Roy D. Chapin fellowship in highway engineering, for investigation of an approved subject relative to hard surfaced roads and pavements.

Two Detroit Edison fellowships in highway engineering, for investigation of approved subjects relative to moderate cost country roads.

Each of these pays $250 with an allowance of $50 for expenses. A Fellow must hold a Bachelor's degree from a college of recognized standing, must enroll as a candidate for the degree of Master of Science and be in residence during one of the three periods, October to February, December to March, or February to June. Applications should be sent to Arthur H. Blanchard, Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich., not later than September 1, 1920.

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Heads I Lose; Tails You Win

If the city of San Francisco awards the contract for its 16 miles of tunnel conduits to either of the bids mentioned on page 400, it is bound to pay a sum probably in excess of the reasonable cost-plus profit involved.

Four bids were opened, the lowest one being for cost plus contractor's fee, which throws all of the risk on the city (where indeed it belongs), but receives an exceptionally large contractor's fee which includes the discount on the city bonds sold below par. The other lowest bid, on unit price basis, is about 28 per cent. larger and puts all of the risk and the discount on bonds on the contractor's shoulders. The difference in the two bids is nearly $2,200,000 and both bids are probably $1,000,000 or more larger than they would be if the city could sell its bonds at par. Under these circumstances it appears that the city of San Francisco is in a position to wish devoutly for better financing.

Reducing Flood Damages

In accordance with the truth, so often demonstrated, that "hind sight is easier than foresight," the state of Ohio, after suffering an immense loss of life and property from the 1913 flood in the Miami Valley has, by legislative action, authorized the expenditure of a large sum of money to prevent the recurrence of the disaster and has appointed an able corps of directors and engineers to plan and execute, at an estimated cost of approximately $25,000,000, protection works, which, had they been completed a few years sooner, would doubtless have effected a net saving of about one hundred million dollars in property value alone in 1913.

Belated though the action is, in view of the recent disaster, it is still timely as an indispensable safeguard against future floods which may become more and more violent as agricultural conditions develop. It is also more than doubtful that the scientific and mechanical facilities and experience available would have sufficed for a thoroughly satisfactory treatment of the problem many years prior to the flood.

Notable features of this undertaking are the thorough investigation, expert tests and experiments that preceded the solution of the problem and influenced the rational decision to oppose the least possible resistance to the great and irregular hydraulic forces and to control and direct them in such a way as to modify their action and guide their operation by the simple expedient of temporarily holding a portion of the flood near its sources and so regulating its flow as to diminish the maximum intensity and protect adjacent property.

This principally involves ordinary river improvements and large earthen dams with concrete appurtenances requiring chiefly local materials and a large equipment of standard heavy construction plant designed to be handled with the minimum operating force. The important structures and building operations are being described by Public Works in a series of articles beginning with the February 14th issue.

This work is worthy of careful attention because it is representative of advanced methods in design and execution of heavy engineering construction that have been developed with special regard to safety, efficiency, rapidity, permanence, and ultimate economy. High ground has been taken in promoting fairness and amicable relations between the owner, the engineer, the contractor, employe and the public. Simplicity and uniformity of design have utilized available supplies and equipment and facilitated the installation of a satisfactory mechanical plant. The specifications have been notably simplified, standardized, and modified and the welfare of the employes has been so successfully promoted as to secure exceptionally abundant and efficient workmen. The selection and distribution of power and the co-ordination of successive operations have reduced the cost of the work, and the adherence to a schedule of operations has proved advantageous.

Increased Immigration Necessary

Increased immigration for this country is not only obviously necessary, but it is reasonable, easy to secure, and will injure neither this country nor the countries from which immigrants come. On the contrary, under proper regulations, it will quickly and directly benefit all those who are concerned.

It is universally known and admitted that throughout the world there are vast deficiencies of food and other necessaries which are causing privation and discontent. The United States, which has the largest resources, highest mechanical development and organization and by far the most abundant capital and facilities, must help the world and, so doing, vastly benefit and enrich herself. To effect this requires only a concentration on essential productions rather than on luxuries, and an abundant supply of reliable labor. Nearly all the labor in this country has been educated and specialized until it is largely classified, demands and receives high wages for skilled services, and is inclined to refuse unskilled employment. This is well and good, and there is enough such employment for all the qualified workers if they can be supplemented by the necessary unskilled laborers. There are unlimited quantities of them in many foreign countries who are anxious to come, and would greatly better their own conditions by working here at rough, unskilled and disagreeable operations for wages that would not be considered by trained American workmen, but yet are adequate for the services rendered. It only remains to secure these men. The only objection to this lies in the unfounded prejudices of the labor trusts, which appear determined to create, by every method, an artificial labor famine to the incalculable damage of the whole nation, themselves included.

We need today 2,000,000 unskilled workers to help raise our crops and build our highways, aiding the mechanics and machines that are ready to carry on unlimited business. All large employers complain that enough common laborers are not to be had, and that they are compelled to pay mechanic's high wages to inefficients for doing a fraction of what good labor should perform. Hundreds of thousands of men and women are anxious to escape the privations and burdens of foreign countries and will come here the moment their rulers and our rulers facilitate their immigration. Let us welcome and assist them.

Mechanical Removal of Snow from City Streets

North of the Ohio river, handling the snowfall in the city streets is one of the most important and difficult of municipal operation problems. As the traffic grows and particularly as the number of surface cars and automobiles increases, congestion increases and the problem becomes more acute, the costs become greater, and the damage and inconvenience due to slow or inefficient work are larger and larger every year.

When there were only horse-drawn vehicles, they were all placed on runners in snowy latitudes, the sidewalks were more or less thoroughly cleaned and no great difficulty ensued. In 1885 or later, no less than four different types of vehicles were regularly operated by the street railway company in Montreal, which in summer ran open cars, in the fall closed cars, in the winter closed cars on runners, and in the spring, when the snow two or three feet deep softened and melted, they used large stages on very high wheels drawn with great difficulty by four horses. Little attempt was made to remove the snow which was shoveled from the sidewalks into the middle of the street, until late in the spring when it became very soft and in a few of the narrowest and most congested business streets a portion of the snow was shoveled into trucks are sleighs, hauled to the river, and dumped.

With the adoption of electric street cars, it became necessary to keep the tracks at least free of snow. This is accomplished in most northern cities of this country either by moving it to one side in heaps along the curb, or by removing it entirely, or by a combination of both methods. In some of the larger cities attempts are made to remove the snow entirely from main thoroughfares, after which in some cities, as in New York, attempts are made to continue its removal from the principal resident streets and cross streets, the latter never being cleared very promptly and often not at all if the snows are frequent or if there are serious labor troubles.

Few if any large cities have adequate snow removing machinery and some have little or none, so that in any event they must depend in emergency, when work should be done rapidly, on private contractors and individuals, thus necessitating a large force of supervisors and accountants and opening the way for high prices, poor work and dishonest practices, some of which it is very difficult to detect or prevent. In the larger cities it is quite impossible to secure enough men and trucks to shovel and haul the snow with anything like the proper rapidity, it is difficult to get satisfactory dumping grounds and the unorganized units are quite likely to get in each other's way.

Many attempts have been made to supplment hand work by various methods such as melting by steam, hot water or even by flame, by flushing the snow into the sewers, and by sweeping, shoveling and elevating and hauling it by machinery. Very promising results were obtained by a new machine put in operation in New York last winter with results described on page 396 and attention is strongly called to the subject by the Women's Municipal League as noted on page 395.

Last winter the city of New York paid snow shovelers a flat rate of 50 cents per hour for very indifferent work by aged men, boys and lazy employes, many of whom evidently did as little as they could. Although they were inefficient and inadequate, trouble occurred with strikes and threats of strikes for increased pay, and even at that there could not be obtained enough men or vehicles, the work was very slow, and the city in a disgraceful condition throughout a large part of the winter, even though the huge sum of $6,000,000 was paid to remove the snow.

Similar conditions may at any time be expected in all of our large cities and a knowledge of them should be more than sufficient to impress the public with the necessity of adopting a satisfactory system of snow removal, making a permanent organization for it and equipping it with abundance of the best mechanical installation that can be procured to do the work efficiently and eliminate the greatest possible amount of hand labor. The equipment should be selected or designed with a view to its full utilization for handling dirt, street sweepings, garbage and ashes the year around, and snow in winter. Different types of machinery should be studied by experts, who would modify it if necessary, and appropriations and authority provided immediately for preparations to be made during the summer adequate to handle the situation satisfactorily next year.

The installation of incinerators in apartment houses, hotels and private homes by property owners if they so desire has been taken under consideration by the Public Utilities Committee of the Board of Supervisors of San Francisco. The constantly increasing prices for the public disposal of garbage is the reason for this move.

Highway Maintenance in Essex County, N. J.

During the past five years bituminous concrete pavements have been laid by county forces at about $1.30 a square yard. They are not suitable for steep grades. Their edges should be protected with broken stone shoulders.

In his report for the year 1919, Frederic A. Reimer, county engineer of Essex County, New Jersey, gives a brief statement of the general methods employed in the repairing and maintenance of the county roads in that county. Omitting references to local conditions and specific roads, this statement is as follows:

For the past five years the county has followed a policy of resurfacing a considerable mileage of the county highways each year with materials purchased under contract and laid by its own forces. The materials purchased under contract have been Type R, Amiesite and Warrenite. Type R and Amiesite have been used quite extensively and with excellent results. Taken over the entire period in which these materials have been used, the average cost per square yard of the material furnished and laid has been practically $1.30 for both materials. On none of the roads which have been laid with this material has there been any necessity for making restorations, with the exception of where cuts have been made in the pavement, and on Northfield road where the edges of the pavement were improperly protected, which caused a rapid deterioration and necessitated considerable repairs this year.

The laying of this material, however, on the mountain roads having excessive grades should not be continued under any condition. Roads of this character require special treatment, and it is improper to lay bituminous materials on these long, steep grades.

There is remaining in the county system today fifty-three miles of the Telford macadam type which must be maintained at as reasonable a cost as possible, and the greater portion of this mileage can be maintained, on account of the small tonnage of traffic using same, by the ordinary stone repairs and road oiling.

With the large mileage of hard surface roads in the county system at the present time, the patrol system should be reorganized to meet these new conditions, and the sections patrolled be lengthened considerably in many cases. The work of the patrolmen over the sections now improved is practically confined to observation of the condition of the pavement and reporting any unusual deterioration which may occasionally occur. There is no reason, therefore, why the patrolmen should not, at all times, keep the shoulders of the road and the gutters entirely free of vegetation or other material which, if allowed to accumulate, is one of the first reasons why the pavements disintegrate along the edges. On the other hand, on the old telford macadam roads, the patrolmen have the double duty of keeping the surface in repair, and also the shoulders and gutters clear of all foreign matter. These sections should be shortened in some cases, so as to assure the pavement being in repair at all times.

In a number of cases where the hard surface roads have been laid in the western section of the county, the edges of the pavement require that they be protected with a shoulder of broken stone, and I recommend that in all such cases this precaution be taken at the earliest possible date.

Wherever steep grades exist on these old pavements, it is an economic waste of labor and material to spread stone screenings over these road surfaces. This material is almost immediately thrown on to the shoulders and into the gutters by vehicles or storms and is carried away in the rush of water into the several culverts along these streets.

Bids for Toledo's Garbage

Five bids for the disposal of Toledo's garbage were received by service director Goodwillie in the latter part of April. Four of the five bids contained offers for paying the city for the garbage. The fifth, from the Toledo Disposal Company, asked payment from the city.

The Toledo Disposal Company now takes care of the city's garbage and is paid $5,875 per year for disposing of it after it has been delivered to their plant. In their new bid they ask 74 cents a ton if granted a 20-year contract and 89 cents a ton if granted a 10-year contract. They use the reduction method of disposal.

Two of the other four bids were for disposing of the garbage by means of hog feeding. One from the A. B. Caple Feeding Company of Toledo offered the city $1.25 per ton for the garbage under a 10-year contract. Another from Harry Conley of Kalamazoo offered $1.26 per ton under a five-year contract.

The Michigan & Ohio Nu-Fuel Co. in its bid proposes to take the garbage and all other combustible wastes, and offers to pay 75 cents per ton under a 20-year contract. This company employs the refuse to make fuel.

The Pan-American Feed Milling Co. offered to pay $1 per ton. This concern would convert the garbage into a commercial food for live-stock.

No decision has been reached as to which bid will be accepted.

Hiawassee Hydroelectric Development

Court decisions are reported to insure the construction of $10,000,000 hydro-electric developments of the Hiawassee river in North Carolina and Tennessee, W. V. M. Powellson, New York, engineer. The developments involve twenty-six miles of land and riparian rights, two 150-foot dams to be built. It is estimated that 60,000 h.p. will be obtainable by the development, to be transmitted for lighting and power purposes in Tennessee and North Carolina.

Los Angeles Sewer Pipe Specifications

Recently adopted specifications give requirements for clay and cement pipe identical in most respects. Sand-bearing pressure, hydrostatic and absorption tests are made of both. Sewer joint compounds are provided for, and test for tightness of completed sewer.

The city of Los Angeles has recently adopted specifications for constructing sewers which contain modifications of the requirements of previous specifications for both clay and cement sewer pipes. We are informed by W. T. Knowlton that the results of tests made by the Engineering Department of the city on sewer pipe used under previous specifications had been tabulated by him and used as a basis for deciding the details required by the new specifications.

The specifications for sewer pipe and for the testing of them are quite complete, and space can be found for only a summary of some of the more important points, without going into all details as to dimensions.

The thickness of shell required is given as ¾ inch for both clay and cement pipe 6 inches in diameter, and for 24-inch pipe, 2 inches for vitrified clay and 2⅛ inches for cement. Depth of socket required is, for 6-inch pipe, 2 inches standard and 2½ for "deep and wide socket" for both kinds of pipe, increasing to 3½-inch standard for clay and 3-inch standard for cement, with four inches for "deep and wide" sockets in both materials. The annular space required is the same for both kinds of pipe, being ⅜ inch for 6, 8 and 10-inch standard and ½-inch for all larger sizes, and ⅝-inch for 6-inch to 18-inch and ¾-inch for larger sizes with "deep and wide socket" pipe.

"The space between the circumference of the lower inside diameter of the socket and the spigot of the pipe placed in said socket shall be not less than ½ the annular space."

PERMISSIBLE VARIATIONS AND IMPERFECTIONS.

For each kind of pipe there is given a table of permissible variations in dimensions, which variations are the same for both kinds. For 6-inch pipe the length may be ½-inch short for each foot of length, the socket may be ¼-inch short, the thickness of shell may be 1/16-inch less; while in all, these may exceed the standard without limit. The inside diameter of the pipe must not vary more than 3/16-inch in either direction. For 24-inch pipe, these variations are ⅝-inch per foot of length, ¼-inch in depth of socket, ⅛-inch in thickness of shell and ½-inch in inside diameter.

It is specified in the case of clay pipe that all pipes and specials must be free from injuries, cracks, checks, blisters, broken rims or other imperfections. As further defining this, a list of imperfections is given which would be considered cause for rejection. These include:

A single crack in the body of the pipe extending through the entire thickness, regardless of the extent of such crack.

A single fire crack which extends through one-half the thickness and over three inches long.

Two or more fire cracks in the body of the pipe of a less length than three inches and extending through one half of the thickness.

Any fire crack which is more than 1/16 of an inch wide at its widest point.

Lumps, blisters or flakes on the interior surface of a pipe or special.

Two or more breaks in the socket or spigot, unless they can be placed in the upper half of the sewer.

When the bore or socket of the pipe varies from a true circle more than 3 per cent of its nominal diameter.

When a pipe or special designed to be straight exhibits a deviation from a straight line of more than ⅜ of an inch.

A piece broken from the spigot end deeper than the socket or longer than one-third of the diameter of the pipe.

A piece broken from the bell end, if the fracture extends into the body of the pipe or is longer than one-third of the diameter of the pipe.

In the case of cement pipe, the imperfections which will give cause for rejection are the same as in the case of clay pipe, except that the word "fire" is omitted in referring to fire cracks, and the sentence referring to lumps, blisters or flakes is omitted.

TESTS OF PIPE.

For each pipe it is provided that three tests be made—sand bearing crushing test, hydrostatic pressure test and absorption test. The first and third of these tests are exactly the same for both clay and cement pipe, but the second, the hydrostatic test, varies slightly.

The crushing test is to be made by bedding the pipe in sand for one quarter of its circumference and applying the load on a bed of sand covering one quarter of the top of the circumference; the depth of bedding above and below the pipe at the thinnest point being one half the radius of the middle line of the shell. The general provisions for the details of this test are similar to those ordinarily provided for tests of this character—neither top nor bottom frame shall come in contact with the pipe, the top bearing plate shall not touch the frame and shall extend the total length of the pipe and shall be rigid, the load shall be applied to the exact center of it by means of a spherical bearing or two rollers at right angles, and a load shall be applied until a specified minimum crushing strength has been reached (no additional pressure being required, but such may be applied for record purposes). The minimum crushing strength required for each kind of pipe, per lineal foot measured on the inside of the pipe from bottom of socket to spigot end, is 1,430 pounds for 6 and 8-inch pipe, 1,570 pounds for 10-inch, 1,710 for 12-inch, 1,960 for 15-inch, 2,200 for 18-inch, 2,590 for 21-inch and 3,070 for 24-inch.

In making the absorption test, the specimen is dried at a temperature of 230 to 260 degrees Fahrenheit and then immersed in water for 24 hours, removed, drained for one minute and weighed. The maximum absorption must not be more than 10 per cent, calculated as a percentage of the final dry weight.

In making the hydrostatic pressure test for clay pipe, when such pipe is subjected to an internal hydrostatic pressure of 10 pounds per square inch during a period of 3 minutes, the exterior surface of each specimen tested shall show no percolation, the term percolation meaning moisture that trickles or runs down the side of the pipe. In the case of cement pipe, the hydrostatic pressure of ten pounds shall be applied during a period of 5 minutes and the exterior surface of the pipe shall not show percolation which will cover a total area of 30 square inches at the end of the 5-minute period, nor shall the accumulated moisture on the exterior surface of the pipe run down the side of the pipe in such a quantity that, when collected, it shall amount to two or more cubic centimeters during the 5-minute period.

SEWER JOINTS.

There are some other features of the specifications which are out of the ordinary. For instance, provisions is made for a sewer-joint compound to be used where specified, it being provided that the compound shall be such that, when heated to not less than 250 degrees F. and poured, it will adhere firmly to the surface of a dry pipe, or, when heated to not less than 350 degrees F., will adhere firmly to the surface of a pipe even though it be submerged in water below the springing line of the pipe. The flexibility of the compound shall be such that, after a pipe joint has been run and cooled, the pipe may be deflected at least five degrees from line or grade, and the compound in the joint show no signs of cracking, checking or breaking away from the surface. The melting point shall be not less than 70 degrees centigrade and the tensile strength at 25 degrees C. shall be not less than 175 pounds and at 40 degrees not less than 100 pounds per square inch. A piece of the compound ⅛ inch thick and one-inch square, if submerged for 30 days in sea water, or crude sewage, a 5 per cent solution of caustic potash, a 5 per cent solution of ammonia, or a mixture of 5 per cent hydrochloric acid and 5 per cent sulphuric acid, shall, when subjected to the above tensile test, show a strength at 25 degrees of not less than 95 per cent of the untreated material.

In making a joint with this compound, the inner surface of the socket and the spigot are painted with the compound. A gasket of dry oakum twisted into strands is tightly driven into the joint with a caulking iron, leaving a clear space of from one-inch to one and one-half inches between the gasket of the outer end of the socket. A greased runner is then placed around the pipe with the pouring opening on the top slightly off center, and the joint space is then completely filled by pouring into it the pipe-joint compound at a temperature of not less than 250 degrees F., the runner being left on for at least 15 minutes after pouring. If desired, pipes may be jointed in pairs on the bank by standing the two pipes on end and filling the bell of the bottom one, in which case no runner is required.

When ever pipe sewer is located within 10 feet of any trees which are to be left in, the joints of the pipes are to be entirely surrounded with four inches of cement concrete, mixed 1 cement, 3 sand and 6 broken stone or gravel.

In the case of wet soil, on the completion of each section of sewer between man-holes, the end of the sewer at the upper man-hole is to be closed to prevent the entrance of water from above, and if water is then found to enter the sewer from the trench in such quantities as to impair its efficiency, the leaks must be located and stopped. (Presumably no provision is made for damming up the ground water in the section being tested. The editor has applied the more rigid test secured by damming up the trench at the lower man-hole and permitting it to fill with water up to the ground water level, all joints to remain tight under the hydrostatic head thus created.)

CONCRETE.

In the specifications for concrete, a limit is placed on the amount of water which may be used, this being 50 pounds of water per sack of cement for 1:1½:3 concrete, 65 pounds per sack of cement for 1:2.4:4 concrete and 90 pounds for 1:3:6 concrete, a sack of cement being taken as one cubic foot. "The amount of water specified includes water already in the concrete materials, and in measuring water, allowance shall be made for water contained in said materials."

It is provided that the concrete mixer drum have a speed of not less than thirteen revolutions a minute and that the concrete shall be mixed in the drum for not less than 60 seconds before any portion of the batch is discharged from the drum, and at least 75 seconds must elapse between the placing of successive batches in the mixer.

Akron's Garbage Reduction Plant Abandoned

Akron, Ohio, has discarded its garbage disposal plant in favor of a new hog farm. This will bring to normal the collection of garbage which, due to the city's inability to get coal to operate the garbage reduction machinery, had been curtailed at least ten tons a day.

Under the new system the garbage is hauled by the city to the hog farm, which is independently owned, and is purchased there. Four thousand hogs will be kept at the farm.

The apparatus at the present garbage plant will be sold. Approximately $30,000 was invested in the equipment. It has been suggested that the building be turned into a rubbish and salvage plant.

Street Cleaning and Paving in Savannah

The city of Savannah has recently purchased for cleaning road and streets, two Elgin pick-up sweepers and one gutter cleaner, which are just being put into service for cleaning the streets in the city. The amount of paved streets will be increased this year by 140,000 square yards of new paving, contract having been let last fall for this amount of "vibrolithic," which will cost about $550,000, and construction on which is to begin on May first. This pavement was adopted after an investigation by the city commissioners of a similar pavement used in Jacksonville.

In addition, there is to be laid this year 100,000 square yards, the kind of which has not yet been decided. Considerable asphalt block has been used in Savannah, but we were informed in this city and also in Jacksonville that these blocks were now difficult to obtain, and probably none of that kind of paving will be laid this year. Two-inch Topeka top on 5-inch concrete base has been quite popular in Savannah. Although a few years ago asphalt block and some other classes of pavement were laid without concrete base on the loamy sand which is found throughout the city and which was thoroughly compacted for a foundation, no pavements are now being laid without concrete base.

Hudson River Vehicular Tunnel

By John F. O'Rourke.

The writer explains the nature of the clay in the bed of the river as he found it in building tunnels therein, and the proposed method of replacing soft material by depositing clay from above; also the concrete block method of construction.

The Hudson river vehicular tunnel has been under consideration for a number of years by two commissions representing the states of New York and New Jersey but the first definite plans were transmitted to the Legislature of the state of New York two years ago by the New York Commissioners. These plans showed a tunnel 42-feet in diameter constructed of concrete blocks at an estimated cost of $12,000,000, exclusive of real estate, engineering, etc. At that time a bill was passed making a provisional appropriation of $1,000,000 and a similar appropriation was made by the state of New Jersey, and under the terms of those two bills the commissions organized an engineering and legal department for future study of the proposed tunnel.

PLANS AND ESTIMATES.

On December 31, 1919, the chief engineer of the commissions, with the approval of a board of four consulting engineers, submitted plans for twin cast-iron tunnels 25 feet 6 inches inner diameter with a cast iron and concrete lining 1 foot 9 inches in thickness. This report condemned the concrete block tunnel plan already approved, and declared that two-line traffic roadways in the tunnels were ample to accommodate the traffic for many years to come. The estimated cost of these tunnels, including equipment, was $22,967,000, exclusive of real estate, engineering, etc.

The writer prepared plans for twin tunnels of the same inner diameter, roadways and sidewalk, lined with concrete blocks 2 feet 9 inches in thickness. His estimate for this tunnel, including the same items, and based on many years' experience in such work, was $15,540,000. Using the same item costs where they applied in common to both tunnels, he made the cost of the cast iron tunnels $30,240,000; the cost in both cases being exclusive of real estate, engineering, etc.

He also submitted plans and estimates to the commissions for larger sized twin tunnels of concrete blocks 2 feet thick that would give a roadway of 25 feet for three lines of traffic, which would cost $17,500,000. He further submitted another plan of larger diameter and same thickness of blocks containing a sidewalk similar to that in the cast iron tunnels and having a roadway 25 feet wide the cost of which was estimated at $19,000,000. The cost in both cases was based on the same item costs as those on which the cast iron and concrete tubes of two line roadways and one sidewalk were based. These plans and estimates were submitted to the commissioners more than a month ago, but no effort has yet been made to explain the engineers' estimate, or refute the concrete block tunnel estimates, except some general assertions in an answer to criticisms of General Goethals. Neither have any details to show how the engineers arrived at their figures been given out.

HUDSON RIVER BOTTOM.

It is known to the writer and has been conclusively shown that the bed of the Hudson river is composed of clay banks similar in all respects from New York to Poughkeepsie to the clay banks along each shore. This was seen in constructing the Poughkeepsie bridge, where the original bed of the river, some 10 feet or 15 feet below the top of the mud, was firm and dry clay in layers which showed its sedimentary origin. At Haverstraw, where extensive cofferdams offshore enclosed clay pits, the excavations resembled in all respects similar clay pits adjoining the brickyards. In driving the Haskin brick tunnels by the pilot system under the North river from Jersey City, the same dryness and firmness was found. This is shown by the fact that ⅛-inch steel plates bolted together and braced by the pilot tube were sufficient to hold the clay at the top and sides for lengths of 2 feet to 15 feet of full size tunnel before building the brickwork, and also in the bottom where the brickwork of the invert was laid on the bare ground.

A striking example of just how dry and firm the ground was in these tunnels is shown in the use of the excavation for embankments, filling the tunnels to the springing line, on which were laid the construction tracks. The writer saw these tracks in use and the mules which pulled the cars used the embankment without planking, which could not be done if the clay were soft.

He also examined the clay in front of the shields in these same tunnels when they were being driven in part rock with cast iron lining. It was in horizontal layers and sufficiently firm to permit of stripping the layers like sheets from a pad.

In the Pennsylvania tunnels similar conditions existed. The writer, who was president and chief engineer of the O'Rourke Engineerng Construction Co., which built these tunnels. became very familiar during their construction with the character of the river bed. In passing under the Fowler warehouse and the bulkhead on the Weehawken side of the river, piles were encountered that extended down to below the bottom of the shield. This clay was cut out vertically for the full height of the shields about 3 feet in front of them, and back to the piles, which were then sawed into convenient lengths for removal. The character and consistency of the clay was the same as in the Haskin tunnels and no sheeting or bracing was focnd necessary to maintain the face of the clay.

Afterwards in driving these tunnels across the river a certain amount of clay was admitted through the shields during each shove. This clay was also firm and dry. Numerous photographs taken while the work was in progress show this, and also that the clay flaked at the end of the "sausages" in layer formations. These layers, as seen in the pictures, show at different angles due to the fact that the layers outside the shield were bent from their horizontal position from all directions towards the opening through which they were forced into the tunnel at ten times the velocity with which the shield itself was shoved forward.

This behavior of the clay was uniform, as was also its always being found in layers, which shows that none of the clay which entered the tunnels through the shields was a viscous fluid, and that the shields were able to displace stiff clay, and not the reverse—that because the clay was displaced by the shields it must be viscous. All claims of viscosity in connection with this original Hudson river bed are as baseless as the other theories for which it is put forward as proof.

All the talk about encountering soft ground in constructing the proposed vehicular tunnel is opposed to the facts as known in regard to the original undisturbed river bed, and to what recent experience in the East river tunnels has demonstrated in regard to displacing soft ground with heavy clay blankets when it is found at depths that would give trouble if allowed to remain without treatment.

During the construction of the East river tunnels for the Public Service Commission, clay blankets were dumped across the tunnel lines wherever the cover was either insufficient in depth or soft in character, of heavy clay which itself was dredged from firm and dry clay banks in the Hudson river and New York bay. This clay invariably pushed the soft material aside and came to a bearing on the hard material, so that even in cases where the tunnel itself was above the bed of the river, the subsequent tunneling was done through these clay blankets with the same ease as if they were original clay deposits.

Alleged "Hudson river conditions" would not exist along tunnel lines properly prepared in this way and the clay bed of the Hudson is an ideal material in which to drive shield tunnels when thus properly prepared. In this firm ground thus prepared, any kind of tunnel could be readily driven, either cast iron, concrete blocks, or brickwork, and any statements to the contrary plainly blink the facts or show the ignorance of those who make them.

The reason for laying so much stress on the character of the river bed is to contradict the statements made in the discussions and to show that it lends itself most favorably to any kind of shield tunnel construction, and not because it is particularly desirable for concrete blocks more than for cast iron.

The principal difficulties in building shield tunnels across the Hudson river will be found in the approaches, as was seen in connection with the Pennsylvania tunnels, where two or three times greater speed was attained in the river. In those tunnels the only tie rods or bracing required was in the hard ground inshore, none being used in the clay of the riverbed. The cast iron lining stood without concrete for more than two years in those tunnels without deformation, other than the 1½-inch shortening of the horizontal diameter which returned to equality with the vertical without assistance.

The soft clay that was found outside the lining, but not at the front of the shields, was due to the water filling the space outside the lining that was exhausted from the hydraulic jacks and also to that squeezed by their great pressure from the clay in front of the shields. This water softened the clay and caused many to think that the clay itself was soft at the sides, which could not be true since it was hard at the face, and was also found to be hard once more at the time the experimental screw piles and the plugs covering the screw pile sections every 15 feet were removed at the time the tunnels were lined with concrete.

CONCRETE BLOCKS WELL ESTABLISHED.

There seems to be an impression that concrete blocks are a new idea in tunneling and that cast iron has been used exclusively. In New York it is true that cast iron has been used exclusively, excepting about two or three thousand feet of brick tunnel that was built by Col. Haskins in the North river, so that engineers whose tunnel experience has been confined to New York seem to look on concrete blocks or other masonry as something experimental for tunnels. About 25 years ago, following the example of the Haskin tunnels, an intake tunnel 1½ miles in length was built from Cleveland out into Lake Erie, under conditions almost identical with the Haskin tunnels. About eight years ago another tunnel three miles in length was built at the same place out into Lake Erie of concrete blocks by the shield method. This tunnel was very successful and on some days a progress of 40 feet was made. At this same time a concrete block railway tunnel was built under the streets of Montreal where the loading is greater than can happen in the Hudson. At Detroit the city authorities have been building brick tunnels for drainage in many places.

DETROIT TUNNELS.

Last year the Ford Motor Co. built a tunnel at Detroit 16 feet in diameter and 5,500 feet long, of concrete blocks in soft clay in six months. The situation at Detroit as regards the hard and soft ground is the opposite of that found in the Hudson, because the soft, amorphous material is generally found under about 30 feet of firm, dry, sedimentary deposit, in which many of the conditions of viscosity erroneously assumed for the Hudson, really exist.

Because of this peculiar soft ground condition, much consideration was given to various plans, but cast iron was finally rejected and the interlocking concrete block tunnel was selected instead. It is now completed and in use and the Ford engineers are very proud of their tunnel. The rings were always in compression and remained truly circular without bracing, as in the Hudson tunnels, under the river.

The engineers of the city of Detroit were so pleased with this tunnel that they permitted concrete block tunnels in general to compete with those of brick and monolithic cooncrete, the result of which is that the O'Rourke Company has contracts for two such tunnels, which will be completed this year. One of them is 16 feet 8 inches in diameter and 10,000 feet long, and the other 13 feet 2 inches in diameter and 6,000 feet long. A third tunnel is now planned, 6,465 feet in length, to go under some of the principal streets. The advertisement says that "materials allowed are brick or concrete segement blocks," so that whoever makes the best proposition for that tunnel will get the contract, whether the method is a patented one or not, if the other conditions are satisfactory, just as was done in the case of the Joy Road and Six Mile Road tunnels already described.

There is also to be built in Flushing this summer a small tunnel of concrete blocks, so that New York engineers who are unfamiliar with concrete block tunnels and some who "cannot conceive" how they are built will have a convenient opportunity to make their acquaintance.

COMPARATIVE ADVANTAGES OF CONCRETE AND CAST IRON.

There is no intention of mimizing the value of cast iron lined tunnels. They answer their purpose very well, but they suffer from two faults that are radically bad. First, they cost twice as much as concrete block tunnels, and next, they take twice as long to build. After the tunnel has been driven it must be lined with concrete, and experience has shown that this takes as long as the driving of the tunnel itself. The concrete blocks, on the contrary, can be driven with at least as good speed as the cast iron tunnels and are finished up as they are erected. The methods of moulding the concrete blocks and erecting the rings have been developed to such accuracy that the inside surface of the concrete block tunnel can be kept as true to line and grade as the inside surface of the concrete lining of the cast iron tunnels has been kept heretofore and kept of uniform thickness as was not done in that case.

So far as bolting concrete blocks to make a connected structure, both as to rings and tube, is concerned, it can be done in a stronger manner than is possible with cast iron, where the bolts only connect the flanges of the plates together and are limited to the strength of the flanges instead of that of the bolts as in concrete blocks.

The method of waterproofing the joints in the concrete is also as reliable as the caulking of the cast iron tunnels, with the additional security offered by the grouting, which of itself always becames watertight by the leaks soon "silting up," as is shown in the numerous deep cellars built of concrete caissons with four floors below water.

The statement that a concrete block tunnel is composed of loose blocks is reckless and irresponsible. The plans are perfectly clear as to the bolting, grouting and waterproofing, and to anyone who is familiar with the erection and finishing of concrete tunnels the efforts to condemn them in favor of something costing twice as much seems very unreasonable.

The further assertion that the joints in the concrete block tunnel would open because of the absurd assumptions in regard to the strains it would have to undergo and that the water would enter the joints and disintegrate the blocks shows ignorance of the long experience the city has had with its precast concrete block bulkhead walls. The greater part of the New York waterfront is lined with these walls and wherever built of that material it is in first class condition today, although exposed to polluted salt water containing all kinds of destructive ingredients, an exposure much greater than would be possible in connection with a concrete block tunnel.

The writer inquired recently of a distinguished engineer under whom a large part of this bulkhead wall was constructed, as to his views in regard to the action of salt water on precast concrete. He writes:

> In reply to your letter of the 29th inst., I have to say that in my experience of nearly a quarter of a century in using concrete blocks (precast) in the waters of our harbor, that I have not known or heard of any damage to them by action of the harbor water below low tide mark.

It is evident, then, that the tunnel line is, or can be made, dry, firm clay to the required distance above the tunnel or tunnels; that the cast iron tunnels cost more than estimated and twice as much as concrete block tunnels; that the concrete block tunnels are shown by experience to have the required strength, durability, watertightness and facility of construction, and that, therefore, it seems that to incur the extra cost and time required for cast iron tunnels is entirely unwarranted.

Recent Legal Decisions

Awards of Public Construction Work to Lowest Bidder.

The Pennsylvania Supreme Court holds that the Act of July 6, 1917 (P. L. 752), authorizing municipalities to provide by ordinance or contract that any part or all of work on public buildings should be done within municipal limits is a special act violating the State Constitution, art. 3, 97, forbidding special legislation regulating labor or trade.

It is also held that an ordinance of the city of Philadelphia, requiring contracts for the construction of public buildings to specify the obligation of departments to have stone cutting done in the city and that proposals shall so specify, violates Act of May 23, 187 (P. L. 230), requiring all work and materials furnished to the city under contracts to be let to the lowest responsible bidder. This is the first time the right of a municipality to require work to be done within the city limits has been directly passed upon by the appellate courts of Pennsylvania, and the decisions of other states are not in harmony; their general trend, however, is to hold such requirement invalid where its tendency is to conflict with statutory provisions requiring contracts to be let to the lowest responsible bidder.—Taylor v. Philadelphia, Pennsylvania Supreme Court, 104 Atl. 766.

Construction Contracts—Careening of Pier.

In a county's action against a bridge contractor for damages because of the careening of a pier, the Kentucky Court of Appeals, Pregoria Bridge Co. v. Floyd County, 205 S. W. 690, held that, where the bridge was constructed in a workmanlike manner and the foundation upon which the concrete base of the pier was placed was agreed to by the county, the contractor was not liable for damages because of the careening of the pier, where it would have been strong enough except for diversion of water due to the accumulation of logs, which the county could have prevented. Where neither the specifications nor the blue-print plans indicated the depth of excavation for the concrete foundation, it was competent for the parties to the building contract to agree in regard thereto.

Recovery for Excavation Work.

A contractor for excavation work, who early discovered false representations as to the character of the work, might then have repudiated the contract and recovered the fair value of the work done and material finished. It has been held (Sharp v. Mayor, 40 Barb. N. Y. 256) that a municipality may be charged with responsibility for misrepresentation which have been made by its agent to induce a person to enter into a contract with it.—Prest v. Farmington (Me.), 104 Atl. 521.

Inaccurate Final Estimate.

The West Virginia Supreme Court of Appeals holds that, though a railroad construction contract provides that the chief engineer of the railroad company, before the payment of the final estimate, may require of the contractor "apt and proper release of all liens of laborers, materialmen, subcontractors, and others for any work done upon or material or supplies furnished for the work embraced in the contract," nevertheless, if the conduct of such engineer in preparing the estimate was fraudulent, or if he was guilty of an inaccuracy so gross as to imply bad faith or a failure to exercise an honest judgment, the contractor is not bound by such estimate and need not tender such releases, but may maintain an action on the contract to recover the true amount due him.—Vaughan Const. Co. v. Virginian Ry Co. (W. Va.), 97 S. E. 278.

Rights of Subcontractors.

In an action against the principal contractor for sewerage and pipe-laying in the streets of a town, the town, and the surety company for the faithful performance of the contractors contract, the North Carolina Supreme Court holds Scheflow v. Pierce (N. Car.), 97 S. E. 167, that a subcontractor of the sewer work, on the failure of the principal to pay for work done, may recover on the principal's bond, given pursuant to Laws 1913, c. 150, as amended, requiring a bond conditioned for the payment of all labor done. The contract of the principal contractor with the city being to do that very work, and the contract with the surety company, being that he shall faithfully perform all the provisions of his contract, which included this very trenching which the plaintiff had done, and which the principal contractor contracted to "furnish at his own expense," it followed that the plaintiff was entitled to sue as beneficiary under the contract, and to recover of the surety company the balance due by the principal contractor for the execution of such work by the plaintiff.

Contractors' Bonds—Discharge of Surety.

The California Supreme Court holds that tubing at the end of which was attached a knife, used solely as an appliance in perforating the casing of a well, which the contractor retained unimpaired save for wear and tear, was not within the California Statute of 1897, relating to bonds on public improvements, and requiring a bond to pay for material and supplies furnished "for the performance of the work." Rental and transportation of tools used, however, are within the statute.

A materialman on a city contract, before filing any against the city for labor or material, gave the city written notice that it released the city from all claimed and authorized payment to the contractor. It is held that this notice was of no effect, there being no enforceable claims to release until claims were filed; and hence the notice did not affect the liability to the materialman of the surety on the contractor's bond.—Sherman v. American Surety Co. (Cal.), 173 Pac. 161.

NEWS OF THE SOCIETIES

May 10-11.—AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15.—LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

May 19-21.—INDUSTRIAL RELATIONS ASSOCIATION OF AMERICA. Auditorium Theatre, Chicago.

May 24-26.—NEW JERSEY STATE BUILDING TRADES COUNCIL. Atlantic City, N. J.

June 16-18.—NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual Convention, Asheville, N. C.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada, Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

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CHICAGO BUILDERS ASSOCIATION

For several weeks this association has been in almost daily conference at the request of the Building Trades Council, with bankers, material men, architects, real estate dealers, and contractors to prepare agreement for readjustment of wage rates It was agreed that conditions do not warrant any increase in wages and the contractors and Chicago Building Trades Council recorded their opposition to the incessant strikes, their determination to have all jurisdictional disputes settled by the local joint conference board subject to the appeal of the National Board for jurisdictional awards.

MISSISSIPPI VALLEY ASSOCIATION

The Mississippi Valley Association, organized last year to direct the public policy of the 22 Mississippi Valley states that constitute 53 per cent of the voting power of Congress, met in convention in St. Louis, April 20 and 21, with an attendance of 350 delegates from 49 different cities in 19 of the Mississippi Valley states. The program was joined to that of the Mississippi Valley Water Ways Association, whose convention preceded this one by one day, and was addressed by a number of eminent men including Major General Lansing H. Beach, chief of engineers of the United States Army; Brigadier General Frank T. Hines, chief of transportation of the United States Army, and being in charge of the Mississippi-Warrior Waterways; Joshua W. Alexander, secretary of commerce, the governors of Louisiana and of Arkansas and several other prominent men.

Discussing foreign labor and social unrest, Governor M. Parker of Louisiana stated that socialism is due primarily to low classes of foreign labor that have not assimilated American ideals, and that they must be taught or be shown that any man who seeks to destroy property shall be regarded not as a laboring man, but as a criminal, and treated as such, and that when any laboring man is elected to public office in the United States, he should be compelled to take out a withdrawal card from his union and cease to be a union man until his period of office holding expires. Resolutions were adopted calling for Federal legislation to make strikes and lockouts in public utilities and the essential industries unlawful.

H. H. Merrick, president of the Great Lakes Trust Company, Chicago, was re-elected president; J B. Morrow of Cincinnati was chosen executive secretary and James E. Smith, vice-president in charge of waterways. A combination was effected between this association and the Mississippi Valley Waterways Association and New Orleans was chosen for the convention in 1921.

THE NATIONAL CIVIC FEDERATION

The twentieth annual meeting of the National Civic Federation at Hotel Astor, New York, was presided over by Judge Alton B. Parker, and among the subjects presented were: Increased Production through Industrial Training, Arbitration Conciliation and Collective Bargaining, Compulsory Sickness Insurance, and Workmen's Compensation-Occupational Disease, all of which were presented and discussed by very prominent men including Jeremiah W. Jenks of the Alexander Hamilton Institute, Louis B. Schram, chairman of the Industrial Accident Prevention Department, The National Civic Federation, Ralph M. Easley, chairman of the executive council of the National Civic Federation, Allen Walker, Foreign Department of the Guaranty Trust Company, Hugh Frayne, general organizer of American Federation of Labor, Dr. Frederick L. Hoffman, Samuel Gompers, president of the American Federation of Labor, Timothy Shea, president of the Brotherhood of Locomotive Firemen and Enginemen, and others.

CHAMBER OF COMMERCE OF THE UNITED STATES

Increased production and economy in expenditures were put forward by the Chamber of Commerce of the United States in its eighth annual meeting at Atlantic City as a solution of many of the country's industrial and social problems. A national program of increased production was drawn up by more than three thousand business men attending and was put forward in a series of resolutions.

Joseph H. Defrees, of Chicago, formerly vice-president and chairman of the executive committee of the chamber, and at one time president of the Chicago Association of Commerce, was named to head the institution in the place of Homer L. Ferguson, of Newport News, Va., who retired after a one year term.

Among the resolutions of the meeting, which was called an "Increased Production Convention," were those declaring that:

The country's problems can be largely solved through increased production and economy must be practiced by public authorities and by every citizen.

A treaty of peace should be put into effect without more delay.

The government should refrain from entering any field of business where it can be conducted by private enterprise.

American ideals should be maintained.

Railroad transportation facilities should be built up.

Adequate appropriation should be made for development of waterways.

The traction situation should be improved.

Pivotal industries should be protected.

ILLINOIS GAS ASSOCIATION

At the convention of the Illinois Gas Association, Chicago, March 17, the officers elected were W. M. Willett, president; H. H. Clark, vice-president; and R. V. Prather, secretary-treasurer. Among the subjects considered were public relations, research fellowship, heating by gas and electricity, industrial uses, appraisals and rate of return for utilities, consumption and rate, operating expenses.

New Appliances

Versatile Locomotive Cranes.

Locomotive cranes manufactured by the United States Crane Company are equipped with tapered latticed steel booms up to 55 feet long, that can be operated either with ordinary hoisting tackles suitable for general loading, unloading, transporting and construction operations, or can be used with orangepeel or clamshell buckets for loading and unloading sand, gravel, broken stone, coal, or other loose materials, or even for dredging. They are also provided with powerful electro-magnets, enabling them to handle all kinds of iron and steel scrap, plates, castings and other products safely and rapidly without the delay, danger and expense of attaching hooks, slings, clamps or other mechanical devices. They have a maximum capacity of 20 tons and a locomotive speed of 600 feet per minute.

CRANE EQUIPPED WITH CLAM SHELL BUCKET.

Testing and Trouble Finding Instruments.

Valuable instruments for water works departments are manufactured and sold by the H. W. Clark Company. They have put on the market the Clark Indicator, a watch-like instrument with a dial and index showing pressure up to 150 pounds that locates leaks in service pipes by the indicated loss of pressure they occasion. The use of this instrument may often be advantageously supplemented by the Clark Sonofone that locates small leaks in pipes by the sound and has a diaphragm connected to a sectional detecting rod, entirely free from contact throughout its length, that gives a distinct transmission of sound to the diaphragm.

The Clark Service Box and Valve Box Finder acts equally well through ice, snow, concrete, wood, earth or other solid substances and locates boxes that have been covered with earth or whose position has been forgotten. The Clark Wireless Pipe Locater, is useful to find pipes in any position and the Clark Surface Reservoir Gage for water works, can be placed in the engine house and connected so as to accurately indicate the depth of water in the reservoir at any distance from the gage even when the level of the water is below that of the gage.

The Clark Meter Tester is completely equipped with adapters to fit every water meter of every manufacture even though of obsolete type and can test meters singly or simultaneously in multiples up to six.

Magnesia Association Specifications.

The Magnesia Association of America has issued specification A. A. for 85 per cent magnesia non-heat-conducting coverings for power and heating systems, compiled and endorsed by the Mellon Institute of Industrial Research, University of Pittsburgh, and adopted by the Magnesia Association of America, which is intended to supersede all previous specifications. The specifications apply to coverings for all exposed surfaces, all pipes, fittings, or appurtenances carrying steam, hot water or hot gases and carefully designates the materials, form and thickness of coverings for different portions of the plant and under different conditions, thus considerably facilitating the design, purchase and application of the protective material.

Kennedy Valve Mfg. Co.

The Kennedy Valve Manufacturing Company announces the appointment of C. H. Kennedy, M. E., formerly New York district manager, as general sales manager, with headquarters at the plant, Elmira, N. Y.

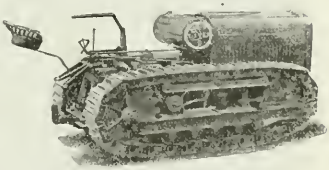
Mr. Kennedy's place in New York has been taken by J. S. Hanlon, formerly Boston representative, and George W. Waters, formerly in the sales department of the New York office, has been made Boston representative.

An additional sales office has been opened at 208 Mutual Building, Kansas City, with F. N. Decker in charge. Mr. Decker has for many years been connected with the plant at Elmira.

The Oliver Tractor.

This machine, manufactured by the Oliver Tractor Company, is especially designed to be operated independent of weather and soil conditions and has caterpillar traction with a bearing area of 1,320 square inches, reducing the unit load to about one-fifth of that of an ordinary man. It is especially efficient for plowing, for hauling all kinds of machinery, for operation on all kinds of soil, and for furnishing belt power.

It is equipped with a 100-pound four cylinder, four cycle, valve-in head lever motor of 4½-inch bore and 6-inch stroke with a normal speed of 900 r. p. m., which uses gasoline or kerosene fuel. It has forward speeds of 1¾ and 2 1/3 miles per hour and reverse speed of 1¼ miles. The two manganese steel shoes are 11 inches wide and 60 inches long loaded to about 5 pounds per square inch. It is provided with transmission of the selective, sliding gear, live axle type, and all gears and pinions are of hardened steel, heat treated and enclosed in dust proof case containing oil bath. It can deliver 30 h. p. through a belt and 15 h. p. through the draw bar and weighs, boxed for export, 8,500 pounds.



TRACTOR WITH SPECIAL LARGE AREA CATERPILLAR TREAD.

INDUSTRIAL NOTES

Abstract of Bids.

This useful souvenir is being distributed among the paving contractors by the T. L. Smith Company, manufacturers of the Smith "Simplex" paving mixer and other items of contractors' equipment. It is a 4¾x8-inch leather-bound booklet and contains a pad with sheets ruled for the contractor to keep a record of all the road bids entered on the various jobs. While sitting in on the "Contractors' Lettings," the contractor can record the figures entered by other bidders and he can keep this information for his future reference and guidance. The record pads are detachable and the company will gladly supply additional pads when the sheets are used up. The book is just pocket size and is fitted with a full-sized pencil.

The Champion Corporation.

The Champion Corporation announces that the former name, Champion Potato Machinery Company, has been changed to Champion Corporation, Hammond, Indiana, to better cover the diversity of their products which, besides various kinds of strictly agricultural machines, includes a sewer cleaning machine that is light, portable and efficient, does not require skilled operators and removes sand, gravel, rubbish, roots and other obstructions from sewers with rapidity and economy.

The Foundation Company, New York

The company announces that Edwin J. Beugler has been made vice-president in charge of engineering, and that Joseph H. O'Brien has been appointed chief engineer.

On and after May 10 the company's New York offices will be located in their own building at 120 Liberty Street.

Sullivan Machinery Company's Novel Publicity.

The Sullivan Machinery Company announces their entertainment as guests of hundreds of mining and engineering school students from all parts of the United States who are taken on trips to the company's plant in Claremont, N. H., and in Chicago to see the construction and operation of drills, coal cutters, quarrying machinery, air compressors and drill sharpener machines. Thousands of miners and engineers also will make the trip during the coming summer, in a mental way, through the presentation of the processes by moving picture films prepared especially for the purpose and loaned to employers who desire to interest and educate their forces. One film is entitled, "Building, Mining and Quarrying Machinery at a Yankee Shop." The other film is called, "The Story of Coal" and is borrowed from the U. S. Bureau of Mines.

Sanitary Sewer Basin Co.

The Sanitary Sewer Basin Co. of Illinois, have opened offices at 549 W. Washington Boulevard, Chicago. They manufacture a patented all cast-iron sewer catch basin and an adjustable noiseless and lock cover patented manhole.

Carl E. Gschwind formerly in business in Youngstown, O., is a member of the firm. He has had many years of experience in the iron industry.

PROBLEMS CITIES ARE STUDYING WITH EXPERTS.

Chester & Fleming, engineers, Pittsburgh, have completed a survey of the water department of Memphis, Tenn., recommending the expenditure of $1,000,000 for the improvement of the artesian pumping and WATER DISTRIBUTION SYSTEM and the construction of a new reservoir.

The city of Los Angeles, California, has created a CITY PLANNING commission of 51 members, from which will be selected an executive committee of 9 members. The commission will prepare and collect plans and suggestions for the various city departments and will classify and coordinate them.

PERSONALS

Knight, Harold, has been appointed regional engineer of the Erie Railroad with offices at Youngstown, Ohio.

Miller, J. J., a retired contractor and bridge and dock builder, died in Brooklyn, February 26th.

Norcross, Orlando W., one of the most prominent and able builders in New England, who for 50 years had been connected with much important building and construction work, died at Worcester, Mass., February 27th.

Salph, Dr. A. V., consulting civil engineer specializing in steel and concrete construction, died at Berkeley, Calif., February 13th.

Deleglise, Alexander, has been elected city engineer of Antigo, Wis.

Eichelberger, F. O., has been appointed director of public service system, Ohio.

Harrison, J. F., has been appointed director of public service system, Ohio.

Grupe, George, has been appointed city manager of Brownsville, Texas, salary $5,000.

Rayburn, J. H., has been appointed city manager of Chadron, Nebraska, salary $5,000.

Mason, Landon R., Jr., of Richmond, Va., has been appointed general manager of the Southern Willite Paving Co., Inc., Broadway National Bank Bldg., Richmond, Va. Mr. Mason spent over four years in the British Army in Gallipoli, Palestine, and on the Western Front, and on his transfer from the British Forces to the American Army in 1918 was Acting Major, Royal Engineers.

Bauer, Chas. F., of Jersey City, for many years with the Uvalde Asphalt Paving Co., has been appointed general manager, Willite Road Construction Co., of New Jersey, with offices at 51 Church street, New York.

Baldwin, A. S., has been elected vice-president in charge of Chicago's Terminal Improvements.

Miller, C. E., has been appointed chief engineer of the Belzoni Drainage District, Belzoni, Miss.

Cheatham, C. W., has been appointed senior highway engineer, Alaska.

Whited, Willis, has been appointed consulting engineer to the Pennsylvania State Highway Department.

Rumpeltin, S. S., has been appointed village engineer of Johnson City, New York.

Moritz, E. A., has been appointed project manager of the Flathead Project, St. Ignatius, Montana.

Giles, J. A., Binghamton, N. Y., has been appointed consulting engineer of Johnson City, New York.

Reeves, C. H., has been appointed superintendent of the department of public utilities, Seattle.

Culverhouse, H. C., has been appointed assistant engineer of the Alabama State Highway Department.

Smith, A. L., has been made division engineer of the Alabama State Highway Department.

Newell, H. F., for several years a member of the engineering staff of the Panama Canal Commission, died at Ancon, April 5.

Gorges, Major General W. G., has been appointed director of extensive sanitary work for the Peruvian government and has sailed from Peru for New York, Belgium and West Africa.

Campbell, G. A., has been appointed member of the Nevada State Department of Highways.

Ellis, J. R., has been made principal assistant engineer to W. L. Winter, civil and hydraulic engineer, Fort Smith, Ark.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

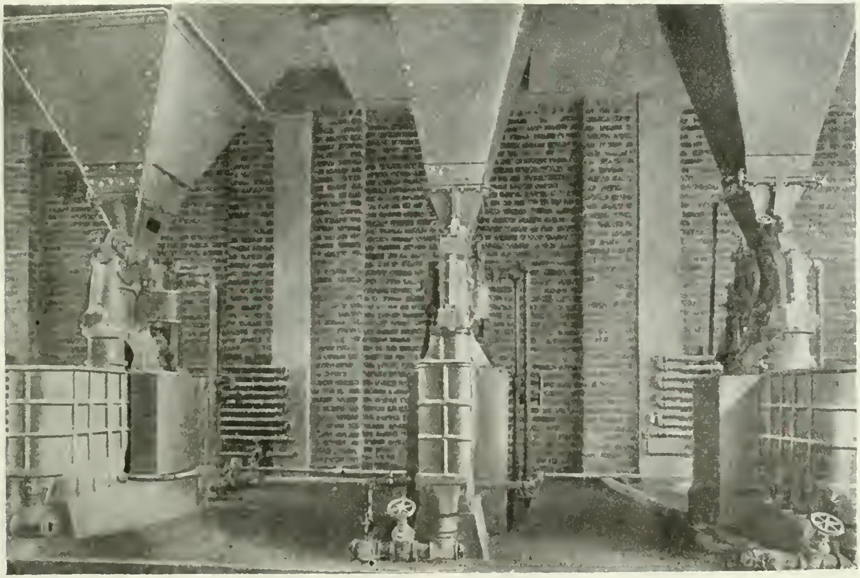
Vol. 48 NEW YORK, MAY 15, 1920 No. 18

The Water Supply of Tulsa

By H. N. Roberts*

The rapid growth and the difficult conditions found in Oklahoma present unusual problems. Filtration is employed, dry chemical feed being used. In 1919 new pumps, mains and intake were installed. It is proposed to obtain a supply from an Ozark mountain stream, building a dam fifty-five miles away, at an estimated cost of five and a half million dollars

The city of Tulsa, Oklahoma, the oil center of the Southwest, if not of the world, where, a few short years ago, prairie dogs, Indians and jackrabbits reigned supreme, has in recent years commenced to grow in that phenomenal way which seems possible only to the great oil cities of recent years. Skyscrapers shoot up seemingly over night, and the dreary wastes of yesterday become the busy, throbbing, twentieth century city of today, where money comes easily and goes even more easily. In 1915 with a population of about 25,000 people, the census of 1920 will undoubtedly show 85,000 inhabitants, and it is estimated that in 1945 the population will reach 170,000.



DRY-FEED CHEMICAL MACHINES, TULSA FILTRATION PLANT.

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* Formerly Construction Engineer for the Tulsa, Okla., Water Dept.

ARKANSAS RIVER, SHOWING DRIFTING CHANNEL.

MAINTAINING CHANNEL TO OLD INTAKE.

To a rapidly growing city the question of water supply is a very important one and requires the foresight of able engineers in order that the supply may ever keep pace with a rapidly increasing demand from industries, domestic requirements and fire protection. Water supply in Oklahoma is a much more difficult problem than in the northern and eastern United States, as the light rainfall and rapid evaporation rate, combined with the scarcity of large forests, render the supply from wells not very dependable; and the flowing streams of the region generally contain such large quantities of mineral salts as to render them undesirable for industrial and domestic waters. And Tulsa must have the best! The new supply, for which bonds in the amount of $5,000,000 were voted last July, will be suitable to the demands of the most discriminating Tulsan, and will be described in this article.

Prior to 1918 the supply of the city was furnished from wells in the southwestern part of the city, augmented by water taken from the Arkansas river, on the banks of which the present plant is situated. The Arkansas river water was settled and coagulated but not filtered.

In 1917 the firm of Archer and Stevens was retained by the city as consulting engineers, and designed a filtration plant to have four filter beds of a maximum capacity of 1¼ million gallons per day each. This plant was completed and placed in successful operation in the early part of 1918. In the design of this plant the most modern appliances were used. A master meter automatically controlled all chemical feed, use being made of the dry feed machines of the Pittsburg Filter Mfg. Co. (who were contractors on the filter equipment).

QUALITY OF WATER.

The Arkansas river water contains large quantities of mineral salts, oil and bacteria. From 100 p.p.m. to 1,000 p.p.m. sodium chloride (or common salt) are found in the water and, as this cannot be removed, the water is suitable for industrial and domestic purposes for only a few months in the year. When the salt content rises above about 500 p.p.m., which occurs for some three months of the year, its taste is very marked and it is not desirable for drinking purposes. The oil scum from the refineries is not troublesome and its removal seems to be mostly effected by the formation of balls on the surface of the mixing chamber in the corners and in the influent flume to the filters just ahead of the skimming weir from the settling basins. As the raw water is also somewhat polluted by sewage, it is a very difficult water to handle, requiring constant and efficient chemical and bacterial control.

Probably very few plants have to deal with a water as bad as this, and when softening is resorted to with the use of soda ash and lime, which will give an effluent with a total hardness of about 140 p.p.m., the chemical cost is quite high. When soda ash is not used and when softening is not resorted to, the total hardness of filter effluent is from 300 to 700 p.p.m. as calcium carbonate, but is uniformly clear and of low bacterial count.

CHEMICAL FEED.

The dry-feed machines used consist of a cylinder with scored or milled surface, onto which the dry chemicals are fed from an opening in the bottom of a large hopper containing the chemical, and whose upper part is charged from the chemical storage room above. The hopper contains slowly revolving paddles to prevent the bridging of the chemicals. The drum is actuated by a water motor whose speed is governed by a water line connected with the venturi meter tube in the raw water line in such a manner that the speed of the drum is at all times proportional to the rate of discharge through the raw water line to the basins. In this manner the drum feeds down over its surface an amount of dry chemical determined by the adjustment, and varying with the flow of raw water. The dry chemical is then mixed with the water discharge from the water motors and carried in open troughs to the point of application in the mixing chamber.

The mixing chamber typifies the best design, consisting of horizontal and vertical baffles (the vertical baffles being removable) and is very efficient. The troughs can be moved about at will and by trial the most economical and effective point for the introduction of the chemical can be found. The economical point is in a great measure dependent on the condition of the raw water, but in general the lime is applied at the entrance to the mixing chamber, most of the coagulation being produced by it. The iron solution is added almost at the end of the mixing chamber, the water having quite a heavy "floc" before the addition of the iron.

To one who has used both methods of feeding chemicals, it is at once apparent that the dry method of feeding, eliminating as it does the bugbear of filtration plant superintendents — the clogging of chemical solution lines, is much the superior of the two. Especially with lime is the dry feed almost imperative and necessary for satisfactory and uniform results.

The filter rate controllers are also of the automatic type, and the rate of filtration is automatically varied up to the maximum, depending upon the depth of the water in the clear well.

INTAKE TROUBLES.

The bed of the Arkansas river consists of a very fine sand, which drifts with the rise and fall of the river and the changing currents. The old intake, which was a 21-inch vitrified clay pipe line, had been left some 600 or 800 feet inland by the vagaries of the shifting currents and shore line of the river, and this channel had to be kept open by a centrifugal pump dredge boat and at times by teams and men at quite a large expense. A new intake line had been contemplated for 1918, but war conditions and insufficient funds made this impossible. In the early part of 1919, however, a contract was let to the Lantry-Fike Construction Co. for the construction of a new intake line consisting of some 400 feet of 30-inch bell and spigot cast-iron pipe to a manhole on the shore line, and about 400 feet of 30-inch spiral riveted pipe to an intake tower on an island, where deep water had always been maintained and a careful study of the currents seemed to indicate the continuance of a deep channel at this point.

TULSA WATERWORKS PUMPING STATION.

Before the new intake and line had been completed and put in operation, the maximum capacity of the old line had dropped to only some 4,500,000 gallons per day and low water was 6 inches below the top of the 21-inch intake pipe. The peak pumping load at about 7 p. m. was close to the rate of 8,000,000 gallons per day, although the maximum day's pumpage was only 6,000,000 gallons on June 17th. Therefore, to meet the emergency, a motor-driven centrifugal pump was set up on the river bank delivering the deficiency of about one and one-half million gallons per day. By the fall of 1919, however, the new intake and flow line had been completed and this emergency had passed.

OTHER 1919 IMPROVEMENTS.

During 1919 there were installed at the river plant a new 8 m.g.d. steam-driven centrifugal pump for the raw water, two 200-h.p. return tubular boilers, and a 150-foot concrete stack, and two new 1¼-m.g.d. filter beds were constructed.

As the high-lift pumps were of 10 m.g.d. combined maximum capacity (one a 4 m.g.d. Platt and the other a 6 m.g.d. Allis-Chalmers) and as an 8 m.g.d. maximum rate is expected in the summer of 1920, in order to be adequately prepared for the possibility of one of these high-service pumping engines being laid out of service for repairs, and to insure fire protection, bids were requested on a 12 m.g.d. pumping engine in the early part of 1919. The cost of this engine was estimated to be about $80,000. Bids were finally received and opened, the contract being let to the Allis-Chalmers Company, which guaranteed a duty of over 140,000,000 foot pounds per 1,000 pounds of dry steam, as was required in the specifications.

During 1919 about 19 miles of new mains were laid at a cost of approximately $400,000, in size of from 4 inches to 24 inches. Tests made in the business district in 1919 showed that the 20-inch and 24-inch lines from the plant were capable of delivering an adequate supply from the plant, but that more cross connections from the 24-inch line, and more cross lines to complete the gridironing, would be required, in addition to the $400,000 spent in 1919, to render the necessary fire streams avail-

FILTER PLANT, SETTLING BASINS AND PUMPING STATION.

able to all high-value districts. To illustrate the increased demands on a plant in a city of such rapid growth, the following table is given, which also shows the low and constant average rate per capita of population:

Year	Consumption Average Daily Pumpage	Population Supplied	Gallons per Capita
1916..........	2,543,000	38,000	67
1917..........	3,058,000	46,000	67
1918..........	3,719,000	54,000	69
*1918..........	6,079,349	54,000	112
*1920......Est.	8,000,000	71,500	112

* Max. pump.

FUTURE SUPPLY.

The fact that the present Arkansas river supply is not at all times suitable for an industrial and domestic supply, principally on account of the salt content and the great industrial growth of the city, combined with the discriminating tastes of the many families of wealth in Tulsa, combine to make imperative the utilizing of another source of supply that does not have these defects. In the latter part of 1918 Chas. C. Hubbard, the mayor, with his commission, having a vision of the greater Tulsa of the future, retained Henry A. Pressey to report on a new source of supply.

In the early spring of 1919 Mr. Pressey filed with the Commission his report and estimate of cost, recommending the selection of Spavinaw creek with a 55 mile conduit as the most advisable supply for the city. Spavinaw creek has its source in the Ozark mountains of Arkansas, and is an exceptionally beautiful stream for Oklahoma, the water being almost crystal clear, with a total hardness of from 100 to 140 p.p.m., free from sodium chloride and practically free from pollution. It has a drainage area of about 400 square miles and without question will furnish a supply sufficient for a population of 250,000 people. The rainfall on this watershed is somewhat greater than the average in Oklahoma, averaging about 45 inches yearly. This rainfall over the drainage area is estimated to yield 121 billion gallons of water yearly. To make use of this large run-off it would be necessary to build a dam whose crest is 50 feet above the tail water. The reservoir thus created will store approximately eleven billion gallons of water and cover some 1,250 acres of land. The allowable drawdown of the reservoir should not exceed 3¾ billion gallons, or 10 feet of water below the spillway of the dam. A greater drawdown of the reservoir would require auxiliary pumping. After carefully working out a mass curve using government records of rainfall for each month over a period of eleven years, it is found that, with the assumed storage, it would have been necessary to use auxiliary power only 53 days per year for the 11 years, when the city is using 10 m.g.d., and for 102 days when consuming 15 m.g.d. For 7 m.g.d. no auxiliary pumping would be necessary, as the flow will furnish sufficient water to generate power for pumping.

The site of the proposed dam is about 3½ miles above the mouth of Spavinaw creek, where it empties into the Grand river. Natural reservoir locations exist at several points along the proposed conduit line and these are at sufficient elevations to give the water a gravity flow to the various pumping stations. There are to be three line reservoirs of 20 million gallons capacity and one on the outskirts of the city of 80 million gallons capacity. There will be three pumping plants on the line and a pumping and generating plant at the dam with a steam reserve. All line pumping plants are to be motor driven and the power for their operation will be generated at the dam plant. For periods requiring the use of auxiliary power, the steam reserve plant at the dam will supply this, or the transmission line will be connected at the city end with the power lines of one of the power companies doing business in Tulsa. From the last reservoir the water will flow by gravity to the present pumping plant at the river. An emergency intake will be constructed on the line at the crossing of the Grand river.

An estimate of the cost of the proposed new Spavinaw supply would be about as follows:

Dam and power house......................	$255,900.00
Right of way..............................	50,000.00
Conduits and pipe line.....................	3,105,600.00
Large reservoir	404,700.00
Three line reservoirs......................	300,000.00
Power plant	225,000.00
Pumping plants	150,000.00
Transmission line	360,000.00
Houses for operators......................	10,000.00
Land and clearing.........................	150,000.00
	$5,011,700.00
Engineering	250,500.00
Interest during construction................	150,000.00
	$5,412,200.00

Estimated operating costs when using Spavinaw supply in conjunction with present pumping plant:

					Cents per 1,000 Gallons at 7 m.g.d.	at 10 m.g.d.
(a)	Supply				0.72	0.51
(b)	Pumping	Fuel.... Chem...	0.90 0.08	0.88 0.08	0.98	0.96
(c)	Distribution				1.71	1.20
(d)	Administration expense......				0.77	0.54
(e)	Auxiliary pumping...........				0.86	1.17
	Total operating............				5.04	4.38
(f)	Depreciation				1.24	0.87
(g)	Interest				10.62	7.41
	Total overall cost (cents per m. gal.)..............				16.90	12.76

Chas H. Hubbard is the present mayor of the city and to his zeal and foresight for the city's future welfare, with the efficient and energetic aid of the Chamber of Commerce (of which Clarence B. Douglas is secretary) is principally due the success of the $5,000,000 bond issue voted on July 10, 1919. R. E. Curran is water commissioner and during 1919 the writer was engaged as construction engineer under Mr. Curran.

State highways constructed and planned under bond issues in California for the six counties of Del Norte, Humboldt, Mendocino, Lake, Sonoma and Marin total 553.86 miles. Of these 226.47 have been completed, many miles are practically complete and work has begun on all. The expenditures of the six counties to March first total $3,722,378.

Forms for Motor Sweeper Cost Keeping

By John Townshend Child *

Methods and forms devised in Rochester, N. Y., for keeping cost records of street sweepers for aid in controlling work, making budget estimates, comparing and purchasing equipment, and determining special assessments.

After several years of experience in cost keeping work of various kinds, there seems no way out of the conclusion that there should be some standardization of cost keeping methods if cities are to compare their cost records with any degree of satisfaction or value. Cost records of various kinds are usually kept, but seldom are they in any way adequate or complete, or are they tied in with any controlling accounts. Often when costs are wanted on any particular function or piece of apparatus, it requires a great deal of digging into various records and usually ends up with an estimate of certain minor cost items.

It has been the practice of bureaus of municipal research to obtain cost data for all kinds of equipment from other cities and bureaus. In comparing the results obtained, it was found that a great deal had to be taken for granted and that in any instance the figures were not comparable at all on account of the lack of detailed and supporting information, not to mention the different methods of cost keeping. This is very evident also in technical magazine articles. Those whose duty it is to compile cost data complain that the man on the job, such as foreman or machine operator, whose main duties are not clerical, does not turn in accurate or reliable figures, and so the compiler is handicapped at the start and has little faith in the results he gets. This may be a reason, but it is not a good excuse, as it can be overcome to a large degree by training and discipline.

As Rochester has purchased a new kind of street sweeping equipment, an effort has been made to devise cost keeping forms which will in reality cover every cost item connected with it. It is certainly desirable to keep accurate cost records for a trial period at least, and it would seem even more worth while to continue such records for full years or seasons in order to get complete and balanced performance data. At the end of that time it will be possible to really know just what a machine can do and how much it costs under given conditions. If it does not come up to expectations, the reasons therefor will be obvious from the records and the purchase of future equipment can then be made more intelligently.

DAILY REPORT SHEET.

The first form shown herewith was drawn up as a daily report sheet, to be made out mainly by the operator (or inspector, if there happens to be one), and covers the work of one machine. The amount of fuel put into a machine on any given day does not mean anything so far as the amount of work is concerned; but if this record be kept up for a number of days, the actual amount of fuel used can be averaged up and is then of a great deal of value in figuring operating costs.

For the last year and a half an effort has been

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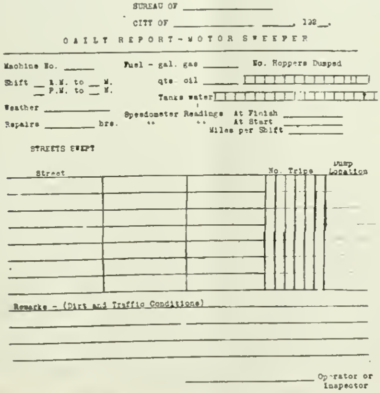
* Assistant Engineer, Rochester Bureau of Municipal Research.



BUREAU OF ____________

CITY OF ____________ _____, 192__.

DAILY REPORT-MOTOR SWEEPER

Machine No. _____

Shift __ A.M. to __ M.
__ P.M. to __ M.

Weather ____________

Repairs ________ hrs.

Fuel - gal. gas ______

qts. oil ______

Tanks water

No. Hoppers Dumped

Speedometer Readings At Finish ________
" " At Start ________
Miles per Shift ________

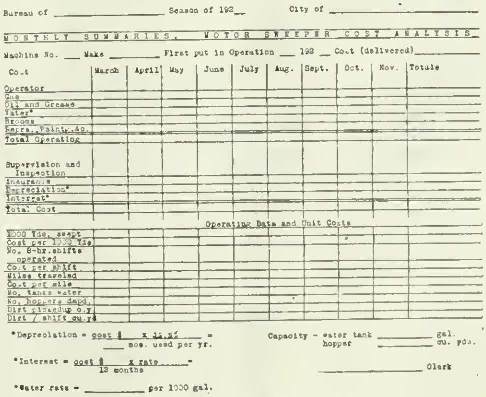
STREETS SWEPT

Street			No. Trips	Dump Location

Remarks - (Dirt and Traffic Conditions) ________

________ Operator or Inspector

FORM FOR DAILY REPORT.



Bureau of ____________ Season of 192__ City of ____________

MONTHLY SUMMARIES, MOTOR SWEEPER COST ANALYSIS

Machine No. ___ Make ________ First put in Operation ___ 192 __ Cost (delivered) ________

Cost	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Totals
Operator										
Gas										
Oil and Grease										
Water*										
Brooms										
Reprs., Paint, &c.										
Total Operating										
Supervision and Inspection										
Insurance										
Depreciation*										
Interest*										
Total Cost										
Operating Data and Unit Costs										
1000 Yds. swept										
Cost per 1000 Yds										
No. 8-hr. shifts operated										
Cost per shift										
Miles traveled										
Cost per mile										
No. tanks water										
No. hoppers dmpd.										
Dirt picked up c.y.										
Dirt / shift cu. yd										

*Depreciation = $\frac{\text{cost \$ \_\_ x 12.5\%}}{\text{\_\_\_ mos. used per yr.}}$ =

*Interest = $\frac{\text{cost \$ \_\_ x rate \_\_\_}}{\text{12 months}}$ =

*Water rate = ________ per 1000 gal.

Capacity - water tank ________ gal.
hopper ________ cu. yds.

________ Clerk

FORM FOR MONTHLY SUMMARY.

made to obtain information concerning the operation of motor sweepers, and out of the 15 or 20 cities reporting not one could or did give the actual number of hoppers of dirt picked up or the tanks of water actually used. Many cities do not figure water as a cost item, but it certainly should be taken into consideration in any case, as it amounts to about $60 per season for motor sweepers. The amount of dirt picked up is valuable in comparing the cost of motor sweeping with hand work. On the daily forms are squares in which the number of tanks of water used and the number of hoppers filled may be checked off. In most cities the fuel used and the speedometer readings are also reported on the daily garage sheets, so that actual fuel, grease and oil costs may be obtained from them.

Number of Trips Per Street.—Another important item in figuring out street cleaning costs is the number of trips made by the machine on a given street. With each width of broom there is a minimum number of trips which would be necessary to cover a given street. The accompanying chart shows the number of trips necessary for the different widths of brooms on different widths of streets for the equipment now on the market. It also shows at which widths the changes become necessary and the table gives the amount of unnecessary lapping. Such a table should be used in laying out routes for motor sweepers. A prevailing width of pavement might be a deciding factor in purchasing equipment with a certain length broom.

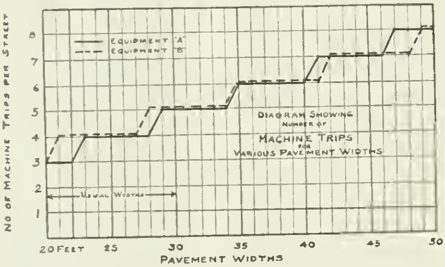


DIAGRAM SHOWING NUMBER OF MACHINE TRIPS FOR EACH OF SEVERAL PAVEMENT WIDTHS.

WIDTHS SWEPT BY DIFFERENT EQUIPMENTS.

	Case A—7 ft. Broom plus 18 in. Gutter Equip.		Case B—7 ft. Gutter Sweeper plus 8 ft. Pickup Sweeper	
Trip	Width Swept per Trip—Feet	Totals	Width Swept per Trip—Feet	Totals
1st	8.5	8.5	7	7
2nd	8.5	17	7	14
3rd	5	22	6	20
4th	6	28	7	27
5th	6	34	7	34
6th	6	40	7	41
7th	6	46	7	48
8th	6	52	7	55

Note:—First two trips only are made with gutter attachment or machine. One trip requires laps on both sides, hence is one foot less.

AMOUNT OF UNNECESSARY OVERLAP, IN FEET, FOR DIFFERENT WIDTHS OF STREETS.

Case A.

Widths of Streets	20	21	22	23	24	25	26	27	28	29	30
Overlap	2	1	0	5	4	3	2	1	0	5	4
Widths of Streets	31	32	33	34	35	36	37	38	39	40	
Overlap	3	2	1	0	5	4	3	2	1	0	
Widths of Streets	41	42	43	44	45	46	47	48	49	50	
Overlap	5	4	3	2	1	0	5	4	3	2	

Case B.

Widths of Streets	20	21	22	23	24	25	26	27	28	29	30
Overlap	0	6	5	4	3	2	1	0	6	5	4
Widths of Streets	31	32	33	34	35	36	37	38	39	40	
Overlap	3	2	1	0	6	5	4	3	2	1	
Widths of Streets	41	42	43	44	45	46	47	48	49	50	
Overlap	0	6	5	4	3	2	1	0	6	5	

The ratio of first costs is 3 for Equipment A to 4¼ for Equipment B. Significant facts, as shown by the chart, are that at pavement widths of 21, 22 and 28 feet, Equipment A requires one machine trip less to sweep the entire pavement than Equipment B. The same number of machine trips is necessary for all other widths up to 50 feet except 41, 47 and 48 feet, where the reverse is true. At pavement widths where the same number of trips is necessary in either case, the work can all be done by Equipment A with the same power unit, while Equipment B requires one motor sweeper for the two gutter trips and another for the remaining trips. However, the gutter machine costs less and is cheaper to operate than the Equipment A machine.

Dumping Dirt.—A question which causes a great deal of confusion in comparing cost figures is the actual method or place of dumping dirt picked up by mechanical sweepers. If dumps are handy, it is much cheaper to have the machine itself carry the load to a given place, but it is not economical to have the sweepers go any considerable distance to do so. If dumps are not near by, the material must be dropped on the street and later picked up by a pick-up team, which of course makes an additional cost. The method or place actually used is seldom reported, hence the last column on the daily form.

The area and kind of pavements are not shown on the form because they can readily be picked off the office records in the department by a clerk and there is no need for duplicating the work or making extra or unnecessary field work.

Dirt and Traffic Conditions.—It seems advisable to have a few lines for remarks on these daily forms to cover dirt and traffic conditions. For instance, if there are a large number of automobiles parked on a given street, it is impossible for the motor sweeper to work along the gutters, where three-fourths of the dirt is usually located. When such conditions occur, it probably would be advisable to shift the machine to some other street or have the work done on that street at night or some other hour. A few notes would explain why certain streets were not cleaned and account for delays and changes.

MONTHLY SUMMARIES.

The second cost sheet is designed for monthly summaries so that the records for a season may be summed up on one sheet and the actual unit costs figured for an appreciable period and an average struck off. The blank gives space for the date the machine was put in operation, which is frequently wanted and seldom recorded. The same is true of the price, from which the depreciation and interest should be figured. It has often been necessary to dig into records several years old to find out the cost of certain apparatus, and very often the results obtained are only approximate or dependent on some one's memory.

In addition to the operating cost, there should be some definite way of computing overhead expenses, because cost data, as usually handed out, do not state whether only operating costs are included or whether they cover overhead expenses or not. If they do include overhead, it is often difficult to decide how it is figured. On the form shown there are spaces for all necessary items, and below is given the method of arriving at these items, together with spaces for the local rate for water and the capacities of the water tank and the hopper, which are seldom given and frequently not known accurately unless a catalogue is handy.

Many untrained officials do not realize the value of cost keeping or else do not care to spend the money for it. Others have the records kept, but they are so out of date when completed that much of their value has gone. Cost records are valuable in controlling work, in making adequate budget estimates, in comparing and purchasing equipment, and in determining special assessments, but they must be kept up to date and be accurate and complete.

City Planning Legislation

The efforts of the Chicago City Club to secure beneficial state legislation for city planning have resulted in the formation of a city planning committee which has drafted a preliminary outline of needed city planning legislation and widely circulated it throughout the country to city planners, with a request for criticisms. Subsequently the chairman of the committee was appointed to a new committee on State Constitution intended to promote the consideration of the city planning subject, and the city club has appointed a new committee on city planning legislation which includes representation of the zoning committee of the city club.

The zoning subject is considered to be the most important one now in the field of city planning and the City Club has suggested a form for the new zoning commission and has participated in the organization of the citizens' zone plan conference, which latter, however, failed in its attempt to secure the control of the building height limit which, despite their protests, has been increased by the city council.

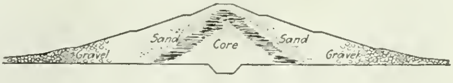
Hydraulic-Fill Dams for Miami Conservancy District

Conclusion of article in last week's issue. Description of method of building up the levees, beaches and water-tight core by means of steam shovels, "window" pipes and other contrivances.

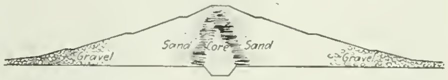
DEPOSITION OF HYDRAULIC FILL.

The Miami hydraulic fill dams are built either as a continuous structure, handled in a single section and in uninterrupted operation from end to end of the longitudinal axis, as at Germantown (where the flow of Twin Creek passes through the dam in a covered culvert, permitting the embankment to be built over it); or in successive sections, as at Englewood, where the dam could not be raised high enough the first season to carry it over the conduit for the Stillwater river, and it was necessary to build the lower portion of it on opposite sides of the river in two separate sections, which could not be joined until after the first season's work had been completed. In both cases, the method of procedure and the operations are substantially the same as those here described and illustrated with photographs of the Lockington, Englewood, Germantown and Taylorsville dams.

The dam is composed of a number of similar horizontal strata extending across the full width and length and consisting of three longitudinal elements. The first element is a pair of levees with trapezoidal cross-sections, usually about 8 feet high, each of them located with one inclined surface in the upper or lower slope of the finished dam and having some of the coarsest material, namely gravel and small boulders, on its outer face. The second elements, adjacent to the levees, are also trapezoidal in cross-section, with their long parallel sides from 2½ to 4 feet apart vertically and inclined downwards slightly from the levee to the axis of the dam. These two elements and the levees symmetrically arranged on opposite sides of the axis, form the bottom and edges of a very wide shallow upper trough and a narrower and deeper concentric trough which latter, for each stratum, is

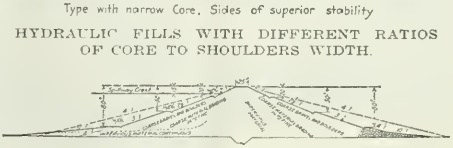


Type with wide Core. Sides subject to falling into Core



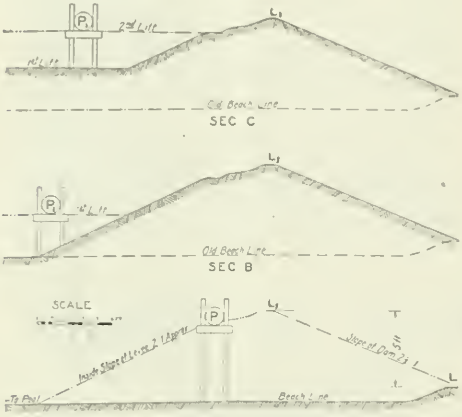
Type with narrow Core. Sides of superior stability

HYDRAULIC FILLS WITH DIFFERENT RATIOS OF CORE TO SHOULDERS WIDTH.



TYPICAL CROSS-SECTION OF HYDRAULIC FILL DAM.

filled to about the full thickness of the stratum with a horizontal layer of the very finest material precipitated from the water delivered by the dredge pump. As the height of the dam is increased the thickness of the strata and the size of the levees remain approximately constant, while the relative width of the second and third elements, the beaches and core, varies so as to maintain the width of the core about equal to the vertical distance from it to the crest of the dam.



SUCCESSIVE POSITIONS OF DISCHARGE PIPE FOR BUILDING ONE 8-FOOT LEVEE AND TWO 4-FOOT LIFTS OF SHOULDER AND BEACH.

The end of the discharge pipe is supported on trestles at a height of 4 feet, corresponding to the thickness required for the stratum. The larger stones up to 6 inches in diameter drop from the mouth of the pipe and quickly form a conical heap as high as the bottom of the pipe, over which the water flows in every direction carrying the remaining stones and other solid materials with it and soon building up the surface to the under side of the pipe in the rear and building a flat slope from the pipe to the levee and in the opposite direction for a long distance toward the center of the pool until all of the sand and fine gravel have been deposited and the slope terminates along a well-defined line, where the inclination becomes much steeper, marking the inner edge of the shoulder. Sheer boards are set up edgewise near the end of the pipe to divert most of the water transversely toward the axis of the dam, where it runs in small streams, dropping the sand and gravel as it goes but retaining the fine sediment until it reaches the sharper slope, where it falls into the center pool and, becoming quiet, deposits most of the sediment as fine, soft silt in a nearly horizontal plane.

As soon as the sand and gravel have been built up to the bottom of the pipe, an additional 16-foot section of the pipe is connected on, and the process is repeated to the opposite end of the dam, building up the shoulder the full length of the levee and forming a wide, flat slope with the steeper inside edge called the "Beach."

BUILDING THE LEVEES.

Usually two pipe lines are in simultaneous operation, one on each slope of the dam, and the attendants are so fully occupied in handling them that they have not sufficient time to build the levees by hand, in which case the latter are constructed principally by the use of small drag-line excavators moving along with caterpillar traction on the smooth, solid gravel beach a little in advance of the pipe discharge.

On the Englewood dam, type 36 Marion machines with 40-foot and 50-foot booms and 1½-yard buckets precede the dredge pipe outlets, digging up enough coarse material deposited by them on the previous trip to build levees 8 feet high so as to serve for two strata of the beach. The draglines place the material in the levees and outer slopes of the dam embankment so well that very little hand dressing is necessary.

Six men are necessary to quickly shift the sections of the discharge pipe, and at Taylorsville, where only one pipe is operated, these men have sufficient idle time between shifts to build the levees by hand. This work is facilitated, however, by a special device called the "window pipe," which deposits the larger stones in a line of small piles close together under the pipe, so that they can be raked or shoveled to place in the levees with minimum labor.

Six 16-foot lengths of "window pipe" each have

BUILDING LEVEE WITH "WINDOW PIPE" SUPPORTED ON PERMANENT TRESTLES AT END OF DISCHARGE PIPE.

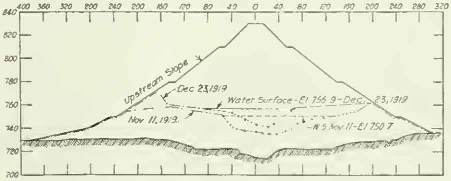
three 4x6-inch rectangular holes on the lower side, the long dimensions being parallel with the axis of the pipe. The solid material, passing through with a velocity of 15 feet per second, is most of it carried over the holes, but enough sand and gravel to make the levee drops through in the 96 feet of perforated pipe, the position of which is shifted three times for the construction of one section of levee.

At first the pipe is installed as indicated in section A, 5 feet above the surface of the beach on a rough timber trestle 4 feet eccentric from the axis of the levee at L, the position of the old levee being shown farther at the right in the outer slope of the dam at point L. In this position the levee is filled up to the position indicated by the slope lines, after which the pipe is taken apart length by length back to the starting point and run down the length of the dam in the new position P 2, section B, where it is lowered to a height of 2½ feet above the beach and supported on a new trestle, the old one being abandoned and left permanently embedded in the levee. In this run the "window pipes" are replaced by ordinary pipes, the levee having been completed, and all of the material carried through the pipe is deposited in the beach, building it up 4 feet to the first lift, as shown by the line broken with two dots in section B.

The pipe is again taken apart, section by section, back to the beginning of the line, the sections being left in position ready for use again, the trestle abandoned as before, and a third trestle is provided on which the pipe is placed as shown in position P 3, section C, and the pipe is gradually extended the full length of the levee, building up the second 2½-foot lift of the beach to the position shown by the horizontal line broken with two dots, and thus completing the operations ready for the construction of another levee, and so on. In this case the slope of the beach is about 1 in 25, making it necessary to execute the work with short lifts in order to keep the width of the beach down to about 62½ feet and prevent the deposition of fine material on it.

The slope of the beach is determined by the size of the sand and gravel; when it is fine the slope is flatter, and when it is coarse the slope is steeper. The core which is built up in the pool between the beaches is composed wholly of very fine material consisting of about 85 per cent of clay and silt and 15 per cent of very fine sand, which are, when first deposited, soft and unstable and are supported by the stability of the sand and gravel shoulders formed by the beaches on both sides of the pool.

The height of the water in the pool is governed by regulating the elevation of the overflow at the lower end. When this is maintained at a high elevation as compared with the elevation of the discharge pipe through which the material is delivered to the beaches, the width of the pool is increased, thus increasing the width of the core and diminishing that of the beaches; and when the elevation of the outlet is lowered, the reverse takes place, diminishing the width of the core and increasing that of the beaches so as to give stronger shoulders, which should be proportioned according to the ratio of coarse material and fine sediment in the water from the dredge pump.



CORE SOUNDINGS IN POOL OF GERMANTOWN DAM.

The accompanying diagram indicates the varying proportions of core and shoulders which have been determined here to be most desirable, with the base of core about one-eighth the total thickness of the dam and never more than one-fifth of it.

As the construction progresses, the lower part of the core gradually becomes harder and denser until it is very compact. Its condition is determined by sounding with a 6-inch cast-iron ball, which will settle through the soft mud and finally stop in the

CORE POOL, BEACHES, PIPE LINES, AND LEVEES AT EAST END OF ENGLEWOOD DAM.
Looking down the center line of the dam, showing the "cut-off trench" in the foreground and the "cross dam" at the end of the pool.

harder material. Soundings thus taken last fall in the Germantown dam pool are indicated in the accompanying drawing, which is made with the vertical scales double the horizontal scale and with the slopes of the beaches and levees indicated by lines broken with one and two dots. The elevations where the sounding ball came to rest are indicated by black dots, the position of which shows that the material in the core consolidated with the rise of the water in the pool.

The design and construction of the dams and the details of the hydraulic fill processes have been illustrated in various issues of the Miami Conservancy Bulletin, from which this article has been prepared and the accompanying engravings reproduced.

White River Hydro-Electric Plant

Surveys have been completed for a hydro-electric plant on the White River at Cotter, Arkansas which will involve the expenditure of $15,000,000, about half of which will be required for the construction of a concrete, gravity section dam, 190 feet high and 2,000 feet long, with foundations carried into the solid rock in the bottom of the valley and in the hills on both sides.

The reservoir created by the dam will cover about 50,000 acres, perhaps 10 per cent. is now under cultivation, and will form a very picturesque lake more than 75 miles long in the heart of the Ozark Mountains. The reservoir will be supplied from the drainage of a water shed of about 6,000 square miles and will provide for an initial development of 100,000 h. p. The project is under the direction of the Dixie Power Company, organized in 1911 with offices at Cotter, Ark.

Water Power in Uruguay

The next few years will afford opportunities for the sale of many kinds of construction material in Uruguay, according to a report just issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The biggest single proposal under consideration is an international power plant to be erected on the Uruguay river by Argentina, Brazil and Uruguay. It is calculated that 2,500,000,000 kilowatt-hours per annum could be developed.

Other plans for development of water power are also being considered. A 37,000 acre tract not far from Montevideo is being examined by a commission with a view to irrigation to serve as an experiment and an example. Fifteen cities will install water and sewerage plants within the next few years. Pre-war estimates of this work totaled about $15,000,000. It is probable that a part of the new work will be given to American interests.

To Provide More Water for New York

In the letter tendering his resignation as president of the Board of Water Supply of New York City, John F. Galvin stated that the time was at hand for serious consideration of future additional sources of water supply for the city. The daily use of water exceeds 760,000,000 gallons and the total available supply after the completion of the Schoharie project will not be greater than 1,000,000,000 gallons a day.

Mayor Hylan, in accepting the resignation, stated that he was impressed with Mr. Galvin's recommendation for the formulation of a complete plan covering additional sources of water supply for the fast increasing population, and said that he would take the necessary steps at once to have it put into effect.

More Electric Energy for California

The Pacific Gas and Electric Company, intending within the next two years to spend $15,000,000 for additions and betterments to its gas and electric system, much of the work to be in the development of hydro-electric power plants on the Pit river, has filed with the California State Railroad Commission an application asking for authority to issue $10,000,000 of temporary certificates.

The construction plans will call for power plants developing a mininum of 350,000 horse power. Superior California will thus enjoy an increase of more than 2,000,000,000 kilowatt hours in electrical energy. This is twice the total energy marketed last year by the Pacific Gas and Electric Company.

More Power from Niagara Falls

Army engineers are expected to submit a report soon in which they will declare that there is no objection to an additional diversion of water for power development at Niagara Falls and the lower river rapids. A request has been filed for the negotiation with Canada of a new power treaty, allowing increased water diversion on both side of the Niagara river. It is possible to produce on the American side, with the present diversion, 585,000 horse power. It is believed that this can be increased to 1,000,000 horse power. The power now going to waste represents a mininum of 15,000,000 tons of coal a year, and the whole Niagara frontier is in need of power.

Temporary Disposal of Newark's Sewage

Plans are being worked out by the committee of engineers appointed by city commissioner Raymond of Newark by which the effluent from the trunk sewer may be emptied temporarily into Newark bay instead of New York bay.

It cannot be made a permanent outlet for several reasons. It would be necessary to use a large quantity of chemicals to treat the effluent, costing $300 daily. Another objection is that concerns along Newark bay and Hackensack river would protest the discharge of sewage into the bay. Furthermore, Newark bay is too shallow; and finally, the act creating the sewerage commission establishes the method of disposal.

The committee intends using Newark bay only as a temporary expedient which will permit a much earlier use of the sewer. It is understood that the sewerage commission will dredge the bay periodically as part of the operating expenses.

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Accuracy in Department Nomenclature

It seems to be quite common for cities and states to use very loosely the designations of the subdivisions of their departments or other organization units. As an illustration, we find a state board of health referring in one place to the "Plumbing and Domestic Sanitary Engineering *Division*," and in another part of the same pamphlet to the "*Bureau* of Plumbing and Domestic Sanitary Engineering." Water supply reports issued by a "board of water commissioners" often refer to the "water department" when a study of the city's form of government shows that there is no such thing. In other cases we have a report of a water department referring to a filtration "department" or business "department" as one of its subdivisions.

The matter may be one of no great importance; but too often, we fear, it reflects a looseness in organization and in discipline which can not but detract from the efficiency and effectiveness of the work of the department.

Storing Frozen Water

A new idea for storing water without the great expense incurred by building dams and reservoirs is reported from Salt Lake City as being suggested by the local head of the United States Weather Bureau at that city. The proposition is to collect, during the winter months, the various small surface streams in the mountains by pipes and lead them to sheltered basins and available gullies where the sun shines for only a few hours per day, and either spray the water from these pipes or let it run slowly over the ice already formed. The water would be so diverted to these points during intensely cold weather, and would there freeze into masses which have been referred to as artificial glaciers. It is proposed to thus convert into large masses of ice the water which runs to waste in the winter time. It is found that snow collecting in the high valleys in the vicinity of Salt Lake City does not entirely disappear until late in summer, and it is believed that water frozen into ice in this way would last fully as long, if not longer, thawing gradually during the summer and thus reinforcing the natural flow of the streams. One advantage claimed is that water so retained would not be so stagnant as when stored in quiet reservoirs.

Several communities in Switzerland rely for their water supply upon the melting of glaciers lying in the mountains above them, and there is apparently little question but that ice masses so formed in Utah mountains would similarly continue to melt during warm weather. There are, however, several difficulties which immediately suggest themselves to us. For instance, during the times of very low temperature when the glaciers are being formed, how will the authorities prevent the freezing of water in the pipes by which it is brought to the glacier sites? Would it not be necessary to keep several men continually on the spot during the freezing season, in order to direct the water to the desired points? The desire appears to be to use the melting ice to reinforce the regular flow of the streams during the dry weather of late summer, but the ice will melt when temperature conditions favor and such conditions are likely to occur before the latter part of that season. In other words, we have a reservoir with an outlet which is under absolutely no control, so that the water therefrom will at some times be going to waste, and may have entirely vanished before the time of real necessity arrives.

As to the advantage of thus obviating the stagnation in the reservoir, this seems to be based on a misapprehension, since in large mountain reservoirs there is seldom opportunity for the stagnation of water, and the character of the water is generally improved rather than deteriorated by its retention in and passage through the reservoir.

Secure Immediate Labor Immigration

Do not merely wish for immigration, or suggest it, or approve it, but work vigorously to get it and to get it promptly and abundantly. It is the great need of this country and it must be supplied to restore conditions to normal. Many important public and private enterprises are being slowed up, or postponed for lack of labor.

Large employers of labor who have recently been questioned all complain of the great scarcity of labor and the failure of formerly successful methods of securing it. Now whenever they need an extra force, they have to search for individual laborers and get them slowly, in small quantities, and at high prices instead of having an abundant supply applying for employment wherever there was word of work in progress, as was the case five years ago. The result is that the volume of work is decreased, its cost increased, uncertainty prevails, consumers suffer and capital is more and more withdrawing the support necessary to any kind of progress and construction.

We should have two million or three million more laborers this year and next to build highways, sewers, waterworks, public buildings, dwelling houses and all sorts of construction and to assist the skilled labor in the operation of public utilities and, equally important, for all sorts of agricultural, mining and other production work that is far behind the requirements.

This scarcity is universal and well recognized and must be met like that of any other commodity, by purchase where it is to be had. Sufficient labor has never been produced in America where the developments have far out-speeded the natural growth of the population and have made conditions so favorable as to normally attract large numbers of workers from foreign countries. The obvious remedy at the present time is to continue and increase the importation of labor and there is no good reason why this should not be quickly and easily accomplished.

In a recent conference with an authoritative official of the United States Immigration Department he stated that there are undoubtedly many hundreds of thousands of foreign laborers ready and anxious to come to this country; that they are mostly of an efficient, desirable class; that agitators and undesirables are comparatively few among them, and can be easily detected and rejected; that they will come as soon as facilities are afforded and continue to come as long as the demands and inducements exist.

It is not only policy, but necessary, to bring these men and women rapidly until the economic balance is more nearly adjusted both in our own industries and in our relations with the over-populated, hungry and idle European countries. To accomplish this there are several specific requirements, first, the revision of our laws restricting immigration and foreign labor contracts modifications that will permit the entrance of some classes now debarred that would give valuable service for reasonable compensation; second, the revision of our passport requirements and the establishment of efficient bureaus for the inspection, selection, direction and classification of laborers at the foreign ports and for their distribution in this country; third, revision and improvement of our requirements and of those of foreign countries so that immigrants may quickly and easily be passed across the frontiers; fourth, the provision of abundant transportation and suitable care and supervision of immigrants until they arrive at destination; and finally, provisions for their Americanization, welfare, and distribution.

These matters should be vigorously promoted by all large employers of labor such for instance, as the great manufacturers, the railroads and other public utilities, state, and municipal organizations and officials and especially by those interested in heavy construction of all sorts that from time to time employ large numbers of unskilled labor.

Every local and national contractors' association should appoint a committee for independent effort and for cooperation with the several General Contractors' Association of America which has already inaugurated a movement of this kind which should be heartily endorsed by its many branches and continuously apply the full force of its influence at Washington and in the great cities. All of these efforts should be coordinated, joint meetings should be held, and a national federation of all employers, including those of domestic servants, should cooperate with commercial, financial, industrial, agricultural and municipal interests and with the labor organizations if the latter will awaken to the necessity of classification, efficiency, production and equity.

Important Steps in the Right Direction

Great satisfaction should be felt in the recent action by the New York State Legislature in passing unanimously a bill making all commercial agreements, all capital and labor agreements, and all other contracts to arbitrate, enforceable by law. If this bill has been so framed so as to be adequate and efficient for the purposes indicated, it is of the highest importance and marks a long step on the only road that will ever lead to sound industrial and construction relations.

It is not less important that the law should be vigorously and universally enforced in spite of the obstructions that will certainly be attempted by bosses, corrupt officials, underground politicians and labor organizations. It is merely in line with the first principles of law and equity that have been applied universally to almost every other business relation and should by no means be abrogated for any favored class. The proper enforcement of this law will, more than any other one thing, remove uncertainty and risk in all kinds of construction and productive operations and establish conditions more favorable to increased production and economy.

It remains to be seen whether it is practicable to enforce the law without supplementing it by one requiring the incorporation of all labor organizations, and thus securing something tangible with which to operate in civil and criminal litigations. The violent objection to incorporation is hardly to be distinguished from the impulse that generally governs the anonymous writer. Any men or organizations which are honest and decent will not seek to evade the responsibility of their acts.

Pipe Rolling

A convenient way of transporting short lengths of large heavy pipe, such as tile or concrete, over smooth level ground is by means of a small roller approximately as long as the pipe which is placed inside the large pipe, the latter lying on its side on the surface of the ground. The axis of the small roller projects beyond the ends of the larger pipe and is connected to a bridle hauled by a horse or mule.

As the mule advances the roller rises up to a convenient heighth on the interior surface of the pipe and the latter rolls along easily and continuously if the surface of the ground permits. This method, of course, can only be used on an approximately level or slightly upgrade.

The advance census report indicates that city populations are increasing from 7 per cent. up to 250 per cent. In the last 10 years, Springfield, Massachusetts, has gained 45.4 per cent. and is now the leading Connecticut river city. It is to be expected that the rural districts far from showing a corresponding increase may show a decrease in population, thus seriously threatening the basic agricultural production necessary to any kind of industry and national prosperity.

Bituminous Paving Suggestions

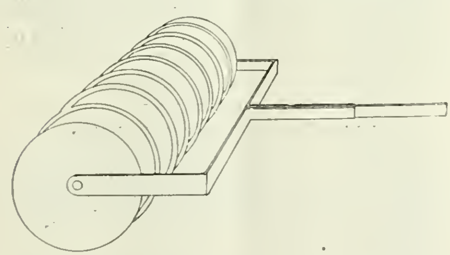
Some details used successfully by Theodor S. Oxholm—corrugating base to prevent creeping of asphalt surface, use of old macadam as base, softness of asphalt that gives the best results, and laying next to rails.

In a paper before the American Road Builders' Association, Theodor S. Oxholm, chief engineer of the Borough of Richmond, New York, described a number of details of his methods of constructing bituminous roads, which were of special interest and most of which are given in the following paragraphs.

LAYING ASPHALT ON CORRUGATED BASE.

Last spring Mr. Oxholm, at the invitation of A. Swan, Jr., C. E., city engineer of Trenton, N .J., made an inspection of sheet asphalt pavements in that city which were laid directly on the concrete foundation without a binder course. Mr. Swan explained that by the use of a special corrugated tamper designed by himself he had corrugated the concrete base so deeply and uniformly at right angles to the traffic that there had been no creeping of the asphalt wearing surface under heavy use for two or more years, and a considerable saving in cost had resulted by leaving out the binder course.

In the Borough of Richmond Mr. Oxholm has been using for some years concrete for pavement base composed of trap rock screenings instead of broken stone and sand, mixed six of screenings with one of cement. It was determined in a certain contract to use Mr. Swan's tamper. After about 300 feet had been tamped, the assistant engineer, inspector and foreman on the work devised a roller made of a 2½-foot section of telegraph pole, with bands of 1-inch round iron fastened around the roller and spaced 4 inches on centers; a long pole attached, so that the roller could move easily, completing the outfit. First, the water was squeezed out of the concrete by a light roller such as is used for concrete pavement, and then, as the concrete was beginning to set, the corrugated roller above described was rolled across the base once for each section. The result was most gratifying, as a perfect series of depressions appeared, 1 inch deep and 4 inches apart, uniform in character and extending the whole width of the base. It will readily be seen that this "washboard" surface will receive the asphalt or bituminous concrete and lock it so firmly to the base that creeping from lack of proper contact is prevented. It is thought that much of the creeping and rippling of the surface of bituminous concrete road surfaces is due to lack of proper contact with the base.



CORRUGATED ROLLER FOR MARKING BASE.

OLD MACADAM AS BASE.

Very often an old macadam road 5 or 6 inches deep makes a suitable base for a bituminous surface, provided drainage conditions are or can be made good. Care must be taken, however, in preparing the old surface, to make it as rough as possible, so as to prevent creeping of the new surface. The bond of the old pavement must not be broken, for if it is, its value is largely destroyed. Mostly all old macadam roads are now surfaced with road oil, which presents a smooth surface in patches. The best method of removing this oil surface appears to be the old-fashioned one of picking by hand lightly so as not to disturb the bond of the heavier stone. Some roads of this type which have been built by the author are quite inexpensive and are giving good service. They are edged with old stone paving blocks set in sand before the bituminous surface is applied.

The placing of a bituminous concrete wearing surface on top of an old penetration macadam road as a base is sure to result in serious damage to the pavement. Wherever an excess of road asphalt exists in the original pavement it will soften the new wearing surface over it and disintegrate it within a year.

While a liberal use of the oil burner in preparing the foundation will improve this condition considerably, yet in the author's opinion this form of old pavement provides a very poor base for a hot mix wearing surface.

Where an old waterbound macadam pavement has been covered with 3 or 4 inches of penetration macadam, and it is desired to place a new wearing surface of bituminous concrete, good results have been obtained by removing the penetration pavement entirely, and forming a new crown and repairs to the old macadam, with new ¾-inch stone and screenings.

PENETRATION TEST OF ASPHALT.

One of the most important defects in bituminous pavements, and one which is undoubtedly caused by the great loads being carried by enormous trucks, is a pushing forward of the top of the wearing surface, creating waves and ripples that sometimes are so marked that the bituminous material has to be removed and replaced. In the opinion of the author, this is caused by requiring a too high penetration test in the asphaltic cement. This has usually been placed at from 50 to 70 in cities near New York, but latterly the Borough of Manhattan has gone to the other extreme and laid pavements at penetration of 30. While the author believes that cracks in bituminous surfaces are preferable to ripples, and can be more economically repaired, yet a medium hardness should be called for. He suggests 45 to 50, and has been laying considerable pavement at 48 during the past summer.

LAYING NEXT TO RAILS.

Bituminous pavements adjoining the rails of street car tracks should be protected from disintergration caused by vibration of the rails. In many cities this has been neglected.

It is impossible properly to compact the bituminous material under the head and flange of the rails. The vibration during the passage of cars destroys the bond of the bituminous material, allowing surface water to enter the space thus formed, resulting in the final disintergation of the pavement. This defect may be obviated by the use of stretcher courses of stone blocks along both sides of the rails. The width of the stretcher area should be sufficient to permit the ordinary rail repairs to be made without cutting into the bituminous pavement.

Another method of construction is to pave up to a steel angle iron laid parallel to and adjoining the rails, the pavement then being practically independent of the railroad tracks.

Iowa Highway Commission Locates Road Material

During the past few months engineers of the Iowa State Highway Commission have been endeavoring to locate new deposits of materials suitable for road construction and to investigate existing plants for supplying such material with a view to learning the quality and quantity with which road materials could be made available this year. Their studies up to April indicated that the capacity of the various plants now producing paving materials would be great enough for the amount of work which seems probable for this season. However, transportation difficulties make it imperative to secure material as near as possible to each job.

Heretofore material from South Dakota and Minnesota has been used extensively for work in northwestern Iowa. In view of the extensive road program contemplated in both Iowa and Minnesota it seems desirable to endeavor to locate local supplies in the northwestern part of Iowa. It was therefore fortunate that a deposit of good gravel has been found on the line between O'Brien and Clay counties, which will be more than sufficient for 22.6 miles of road contemplated in this vicinity.

An immense deposit of gravel, hitherto almost unknown to road builders, has been located in Jackson county, in the eastern part of the state. What apparently totals to millions of tons of good road-building gravel has been found in a terrace which was undoubtedly the bed of the Mississippi river during a period of the Glacial Age. The river is now from a half to ¾ of a mile east of this gravel deposit and 20 or 30 feet lower. The deposit is apparently at least 60 feet deep on its eastern edge, about ½ mile wide at a maximum and between two and three miles long. The gravel is reported to be of excellent quality.

Several other new pits have been located. In general, a study is being made of available near-by material in connection with each road project, as far in advance of the letting as is possible. These studies include investigations, not only of the available sources, both developed and undeveloped, but also the quality of material, price, transportation cost and probability of delivery at required rates.

In general the price per ton of sand in Iowa averages 75 cents at the plant. Screened gravel sells at $1.50 and crushed stone at $1.50 to $2.00.

Planning an Ideal Road

The Board of Directors of the Lincoln Highway Association has sent a circular letter to highway engineers and commissioners, asking their suggestions for the construction of what they would consider an ideal road, with a view to constructing on the Lincoln Highway a section of road embodying the ideal which should finally be adopted after consideration of the various suggestions presented. A competent board of highway engineers and other authorities will pass upon the suggestions made, and will determine within the next few weeks what plan will be adopted and built. The idea is not to build the most perfect road that money can provide, but to keep strictly within the practical from a financial as well as an engineering point of view. Taking into account the traffic which may be anticipated on the Lincoln Highway during the next twenty years, the road should be that which would show the maximum ultimate economy.

The suggestions called for are not so much as to the surface material, but rather to the broader features of the design; for instance, whether there should be two traffic lanes, or four lanes, or four lanes each in a separate strip for the segregation of traffic, etc. Also width of shoulders, size and shape of drainage ditches, location of trees, hedges, lighting poles, etc., are to be considered.

This section of road is to be a model in the sense that it is hoped that it will serve to stimulate imitation by the various states, counties and communites through which the Lincoln Highway runs. This particular section will be paid for by the Lincoln Highway Association, the funds having been provided by C. B. Seger, a founder of the association and the president of the United States Rubber Company, and by J. N. Gunn, president of the United States Tire Company and director of the association.

Michigan Good Roads Association

The preliminary arrangements for the annual convention of the Michigan State Good Roads Association, to be held in Lansing in early fall, are now being made. Over 1,500 good roads boosters are expected to be present.

The tentative dates have been set for August 31, September 1 and 2. The program will include one whole day for the State Highway Department matters, the second day being devoted to Michigan state good roads and the third to snow removal and drift prevention.

One of the features of the convention will be the large exhibition of road-making machinery, consisting of everything used in road construction and highway improvement. A suitable place for the exhibit will be found by the Chamber of Commerce.

Asphalt Paving in Oklahoma City

By S. N. JOHNSON*

Oklahoma City, Okla., is starting on a program of reconstruction of streets which were paved about 20 years ago, using sheet asphalt on a concrete base. In reconstructing these, the old concrete base is to be brought to a true contour by building up the deeper depressions with cement concrete and the shallow depressions with close binder.

In the business section, where cars are parked for long periods, a gutter of three-inch vertical-fiber brick set in a mortar cushion and with grout-filler will extend from the curb 10 feet into the roadway, which is 40 feet or more wide. After the brick gutters have set, a two-inch binder course, using a lean asphaltic concrete mixture, is laid and rolled. On this binder course is laid two inches of asphaltic concrete carrying a high percentage of fine material, especially 200 mesh, with the balance of the mineral aggregate well-proportioned up to half-inch material.

The first rolling of this wearing surface is crosswise instead of longitudinal, using a five-ton roller. Because of the brick gutters, this roller can cover the entire asphalt surface with its larger wheel. Immediately following the crossrolling, a longitudinal rolling is given the wearing surface, using an eight-ton tandem roller. Up to date, surfaces completed by this method show a minimum of waves.

Another feature which, in the opinion of the writer, will eliminate to a great extent non-uniformity of surface is the prevention of the asphalt rakers from walking or standing on the hot mixture after it has been handled by the shovellers and prior to rolling. This prevents an excess of mixture in the spots which have been walked upon and which have thus received a certain amount of compression before the rolling is applied.

In this section of the country, most cities demand that automobiles be parked along the curb at an angle of 45 degrees and the gutter mentioned above should take care of this class of traffic during the summer months.

Proposed Subway for Cleveland

Cleveland is taking steps to improve traffic conditions by installing a subway system. A special election was called for April 27, when voters were asked to approve a $15,000,000 bond issue for constructing downtown subways and a leasing contract for the operation of city cars of the Cleveland Electric Railway Company. The plan is for a subway that will carry the surface cars underground from the center of the city to points beyond the congested district on the heaviest traveled thoroughfares. It is proposed to have four initial units.

Shall We Import Chinese Labor?

A prominent engineer suggests this as a solution of the present urgent need throughout the country for unskilled labor to construct our necessary public works.

The following letter, which has been sent by the writer to a number of engineers, suggests one possible solution or partial solution of the problem presented by the scarcity of unskilled labor in this country. We will be glad to publish discussions of the idea by engineers and contractors:

> I have just returned from an extensive trip covering the entire West where I found from the time I left Chicago until I reached the Pacific Coast, thence from the Mexican to the Canadian borders, that the main topic of conversation, whether it was banker, farmer, merchant or engineer with whom I conversed, was the shortage of *unskilled labor*. This because the same was not only affecting the production of their farms and their industries but because it was also seriously handicapping many large engineering projects whose furtherance was being stunted on account of the lack of economical labor as represented by *"the pick and shovel and wheelbarrow man."*
>
> I also found that same of the thinking people of the west were endeavoring to solve the question and have started active work in sounding sentiment as regards the modifying of the Exclusion Act so as to permit the importation of a limited number of Chinese laborers to do the menial and rough work which our white labor will no longer do; such labor to be admitted under the direct supervision of a commission representative of our different governmental departments, the farming, labor and business interests of the country. This commission would supervise their employment so that they would not compete with our American labor nor reduce their standard of living. The importance of the question involved and of the movement impressed me so much that I concluded, on my return to Chicago, that I would endeavor to learn how the members of our profession feel about this all-important question.
>
> As an engineer I am certain that you realize that it is up to us to assist in solving this vital problem of securing a source of supply of common labor which would be both economical and efficient, if we wish to see the many engineering projects, in which we are directly or indirectly interested, completed. Unless we do interest ourselves more than passively I am afraid many of the large projects under consideration will be held in abeyance because there is no question but what one of the greatest items of cost of construction today is labor.
>
> As city engineer of Chicago for 22 years, my experiences have been many as to how the increased labor costs have affected construction. Realizing what the securing of economical labor means to the future of our profession, because of the effect the present abnormal labor conditions is having on capital seeking new development projects, I concluded that it is timely to make a survey and, appreciating your experience I am desirous of securing your valued opinion as to what your views are relative to the importation of Chinese labor under the above-mentioned conditions.
>
> The eyes of the world are upon America. Europe has been drained of its manhood. Continental industry has been crippled beyond hope of immediate reparation and the foodless populations of devastated countries

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*Asphalt Sales Department of the Texas Company, Western Division.

now look to us for salvation. Shall we sit idly by and permit antiquated and perverted notions of "economic necessity" to stultify our efforts? Or shall we assert the cause of righteousness, and recognizing the needs of the hour, pronounce to the world that America is prepared to continue the pace in the race for progress already set by tireless workers of reconstruction?

As the law of supply and demand governs at all times and with the demand here and not sufficient supply available I believe it is up to us to do something. Awaiting your valued opinion, I am,

Respectfully yours,
JOHN ERICSON.

Amendment to Contractors' Relief Bill

By the act of March 2, 1919, money has been appropriated for the construction, repair and preservation of public works on rivers and harbors, and an amendment has been proposed for section 10 of this act that provides for the cancellation of all such contracts awarded but not completed before the United States entered the war on April 6, 1917. It also provides for investigations to determine additional compensation, if it should be paid to contractors, for work done between April 6, 1917, and July 18, 1918, so as to reimburse them for losses sustained on account of increased cost of materials, labor and other unforeseen conditions.

Such action is especially desirable in the case of federal contracts where the contractor is very strictly held to the letter of the specification and must generally fulfill his covenant without regard to contingencies for which he is not responsible and which, in this case, were largely the direct results of government action taken after the contract was awarded.

Stealing Men

Under this title the bulletin of the Associated General Contractors of America deprecates the custom, frequently noticed, of baiting labor away from other contractors regardless of local agreement and emphasizes the necessity of mutual consideration, honesty and cooperation to correct the evil and improve labor conditions.

In discussing the execution of construction work outside of the contractor's home district, it points out that it may be done by joniing the local association of general contractors and participating in existing or new agreements; by independent action after conference and investigation of conditions with local contractors; or by ignoring local conditions, customs, or agreements and out-bidding the existing scale sufficiently to seduce the labor from the local contractors. Instances are specified of the use of the second and third methods which resulted in unjust and harmful conditions which should be strongly opposed.

It is admitted that the present labor shortage and increasing demands for construction will often necessitate revision of existing agreements and scales, but it is obvious that such action should be of a co-operative nature, well considered and conservatively handled, and that no effort should be neglected to harmonize local and outside interests and practices, to avoid industrial anarchy and heavy losses. Where the demand is notably greater than the supply, either some extra attraction must be provided to draw labor from other localities or some work may be suspended temporarily, to maintain the existing scale and assist the balancing of supply and demand. Independent conflicting action of the outside firm should only be tolerated after every attempt at cooperative action with the local interests has been unsuccessful.

Attention is called to the procedure in this case recommended by the by-laws of the Association of General Contractors of America, which provides, in article 1, section 5, that

> Firms or corporations, members of any associated organization of the Associated General Contractors of America, who shall undertake a construction contract outside the jurisdiction of the Associated Organization of which they are members and within the jurisdiction of any other Associated Organization, should affiliate with said other Associated Organization and abide by their rules and regulations at least for so long as said firm or corporation shall continue to undertake construction work within that jurisdiction.

High Cost of Labor Inefficiency

The Industrial News Swocy states that evidence submitted to British Court of Inquiry on dockers' wages showed that cost of unloading vessels is now more than four times pre-war costs, increase being due quite as much to inefficiency of labor as to higher wages; a "gang" at Glasgow formerly consisted of fifteen men and now of nineteen men.

New Immigration Commissioner

The position of Commissioner of Immigration at Ellis Island, which was vacated by the resignation of Frederick E. Howe, has been filled by the appointment of Frederick A. Wallis, New York. The importance of this position is due to the very large proportion of immigrants that pass through Ellis Island amounting to 80 per cent of the total number of aliens entering the United States.

Proposed Remedies for Labor Shortage

Practical measures to relieve the present labor shortage were proposed by The National Immigration Conference, held on April 7 in New York City This gathering included leaders in finance, industry and agriculture, together with labor men and representatives of foreign born groups in America, and was called by The Inter-racial Council, 120 Broadway. The common interest which drew these varied elements together is the need of greater production, more stable labor conditions and a better understanding between the different races living in America

Among the measures proposed was greater protection for the immigrant against fraud, extortion and violence. A Federal Assimilation Bureau should be established to look after the welfare of the immigrant, help him learn our language and place him where he can work to the best advantage of himself and the nation. Standards for citizenship should be high, but useless hindrances and red tape should be done away with.

An advanced immigration policy was advocated as a remedy for the present labor shortage, including the selection of industrious and thrifty men and women of good character, and their distribution to the points where they can do the work for which they are fitted. As an immigrant may be of great value to the country as an unskilled laborer, regardless of his inability to read, it was urged that the present literacy test be eliminated and this would open the gates to unskilled workers in agriculture and industry, construction, railroads and domestic service, where there is a great need for help at this time. Our present labor shortage is estimated at between 4,000,000 and 5,000,000 and this would be relieved by a policy of admitting immigrants without book learning, but of good character, sound body and mind and the Old World habits of frugality and industry.

New York City Wage Scale

The new wage scale in New York effective as of May 1 as approved by the Building Trades Council and the Building Trades Employer's Association follows:

Asbestos workers, boiler felters, pipe covers, insulators, $9; asbestos workers' helpers, $7; blacksmiths on building operations, $9; blue stonecutters, flaggers, bridge and curb setters, $9; blue stonecutters' helpers, $7; boilermakers, $9; boilermakers' helpers, $8; bricklayers, $10; bricklayers' helpers, $7; cabinetmakers, $9; carpenters and framers, $9; cement and concrete masons—; cement, concrete and asphalt laborers, $6.50; composition roofers, foreman, $8.50; dock builders, house shore and sheath pilers (April 1, 1920), 44 hours, $9; electrical workers, $9; electric helpers, $5.50; electrical fixture workers, $9; elevator constructors, $9; elevator constructors' helpers, $7; engineers, stationary, $9; engineers, portable hoisting, etc., $46.75 weekly, broken time, $10; excavators and general laborers, $6.50; framers, $8; glaziers, $8; granite cutters, $9; housesmiths, bridgemen and structural ironworkers, $9; bronze, metal furniture and metal trim workers, $9; housesmiths' helpers, $7; machinists of all description, $9; machinists' helpers, $7; marble carvers, $10; marble cutters and setters, $9; marble cutters' helpers, $7; marble polishers, bed rubbers and sawyers, $8.50; metallic lathers, $9; mosaic and terrazzo workers, mosaic workers' helpers, $6.50; painters (40 hours a week) $8; painter-decorator (gilder) (grainer), $8; pictorial painters, $9; plate and sheet glass glaziers, $8; plasterers, plain and ornamental, $8.50; plasterer modelers, weekly $41.25 to $130; plasterers' helpers, $7; plumbers and gas fitters, $9; rockmen, $6; pipefitters, open cut, $8; compressed air workers, riggers on machinery, dynamos, boilers, etc., $9; rock drillers and tool sharpeners, $7; roofers, tar felt, composition, damp and waterproofers, $8; sheet metal workers, coppersmiths, tinsmiths, metal roofers, $9; sign writers, letterers and stripers $7.50, subject to change; slate and tile roofers, $9; steam, hot water and general pipe fitters, $9; steam, hot water and general pipe fitters' helpers, $7; tile layers, $9; tile layers' helpers, $7; tunnel and subway constructors, $7; technical engineers, structural (38 hours a week), junior, $35; grade B draughtsman, per week, $60; grade A draughtsman, per week, $75; checkers, per week, $90; squad boss, per week, $100; designer, per week $100; upholsterers, $9.25 (40 hours per week); upholsterers on carpet and linoleum, $9; varnishers, $8; wood lathers, $9.

Philadelphia Strikes

More than 7,000 carpenters in Philadelphia are reported on strike for $1.25 per hour and a five-day week. Teamsters and lumber yard employes have joined the strike which has spread to the shipyards and paralyzed building operations. The strike is attributed to radicals on the Delaware river front but the leaders deny that it was associated with the May Day demonstration.

John Bogart

John Bogart, eminent hydraulic engineer, died April 25 at his home in New York City at the age of 84. Colonel Bogart served as an engineer in the Union army in the Civil War, was for six years chief engineer of the Brooklyn Park Commission and for the Rapid Transit Commission, and was associated with the design and construction of park systems for Albany, Chicago and other cities. He was state engineer for New York State for four years and for many years was secretary of the American Society of Civil Engineers, which is much indebted to his abilities and genial personality for its growth during early years.

Colonel Bogart built fortifications at Fort Monroe and was resident engineer of the Washington Bridge across the Harlem River, New York, which is the largest plate girder arch structure in the world and involved many interesting and important features of design and construction. He was associated with much important railroad and harbor work and was consulting engineer for various railroads and corporations.

Colonel Bogart was the engineer for the Niagara Falls Power Company, which built the first shaft and tunnel for the development of hydroelectric power at Niagara Falls, and since then has been prominently associated with a number of important hydro-electric projects on the St. Lawrence river, at the Sault Ste. Marie, in the Far West and in various other places. His wide experience, great abilities and unusually attractive personality distinguished him in a generation of successful engineers, and his loss will be deeply felt by a very large circle of friends and acquaintances.

The International General Electric Company has been awarded a $2,000,000 contract for the first electrification of a steam railroad in Brazil, consisting of a 28-mile stretch of the Paulista railway. Including double track and siding, the total mileage to be electrified is 76 miles. Electric operation is expected to begin July, 1921. Ultimately it is expected that 100 more miles will be electrified. Eight freight and four passenger locomotives will be built at Erie, Pa.

Recent Legal Decisions

RIGHT TO TAKE EQUIPMENT ON ABANDONMENT.

The Supreme Court of the United States holds, Ball Engineering Co. v. J. G. White & Co., 39 Sup. Ct. Rep. 393, that a provision of a contract for public works that in case of its annulment the United States may, at a valuation to be fixed by the engineer, take over any equipment in use in the prosecution of the work, gives it no right so to take over the property of another engaged in the work. W, with whom the United States contracted for the completion of public works after the annulment of a contract with B for doing the work, procured the United States to take implements belonging to B on the premises and allow W to use them. The United States, while claiming the right to take the implements under the contract with B, crediting B therewith, advised W that the United States would not, under any circumstances, be held liable for the seizure. It is held that W. is liable to B for the implements.

PATENTED PAVEMENT CONTRACT, VOID.

(Ill.) Ordinance providing for a patented pavement is void under Local Improvement Act, § 74, because it prevents competitive bidding.—City of Rockford v. Armour, 125 N. E. 356.

Ordinance void under Local Improvement Act, § 74, as to competitive bidding, because providing for a patented pavement, *held* not validated by Laws 1919, p. 884, permitting use of patented articles for constructing streets.—Id.

STREET CONTRACT DEPARTING FROM AUTHORIZATION, VOID.

(Ky.) Contract for street improvement at cost of more than $100, entered into with lowest bidder by chairman of board of trustees of a town of the sixth class, which was a material departure from the contract for which bids had been invited and from the contract the board had authorized its chairman to make, in that it permitted town to release contractor from use of "Tarvia X" binder, provided for by the ordinance and embraced in proposal, and to substitute asphalt binder to be furnished by city, was void under Ky. St. §§ 3706, 3707.—Staebler & Gregg v. Town of Anchorage, 216 S. W. 348.

CONTRACT PROVISION AGAINST LITIGATION, VOID.

(N.C.) Under Laws 1913, c. 150, as amended by Laws 1915, c. 191, requiring public building contractor to give bond for the payment of all labor and material, and giving laborers and materialmen a right to sue thereon, a provision, in a bond by a contractor for the construction of a school building for a city, that no right of action should accrue to or for the use or benefit of any one other than the city, is in violation of the statute, opposed to public policy, and does not prevent a materialman from recovering against the surety, since the statutory provision may not be waived by agreement.—Ingold v. City of Hickory, 101 S. E. 525.

LITERAL COMPLIANCE WITH CONTRACT.

If a bridge has been constructed, not in literal compliance with the contract, but substantially so, recovery may be had for the contract price, less the damages for the failure of a literal compliance; but where it is not built as the contract requires, or substantially so, the one for whom it was built has a right to refuse to accept or pay for it, and the contractor cannot recover the price.—Gaddie v. Hogan (Ky.), 205 S. W. 778.

REQUISITS AND VALIDITY OF CONTRACTS.

NATURE AND ESSENTIALS IN GENERAL.

(Wis.) A party asking relief from a contract freely entered into, in the absence of fraud or overreaching, does not bring himself within the field of judicial relief by showing that the result of the contract is harsh and burdensome—Sheffield-King Milling Co. v. Jacobs, 175 N. W. 796.

(N. Y. Sup.) The manner and form of payment is not an essential part of a contract for the payment of money.—Swedish-American Nat. Bank v. Merz, 179 N. Y. S. 600.

(Ky.) An executory contract which reserves to one party the absolute right to cancel or terminate the same at any time cannot be enforced, mutuality being absent.—Daniel Boone Coal Co. v. Miller, 217 S. W. 666.

(U. S. C. C. A. Okl.) Contract for certain number of cars of gasoline, having been construed by the parties as calling for shipment as ordered during a certain year, the objection of lack of mutuality, in that no time was fixed for delivery except as buyers might order, could not be sustained.—American Refining Co. v. Bartman, 261 F. 661.

(Colo.) Complaint, alleging that defendant city through its park commission made a certain contract, need not plead the commission's authority, nor other matters of evidence requisite to a valid contract.—City & County of Denver v. Bowen, 184 P. 357.

PLACE AND TIME.

(N. Y. Sup.) Where no time of payment is specified in a contract for the payment of money it is payable immediately.—Swedish-American Nat. Bank v. Merz, 179 N. Y. S. 600.

(Mont.) An option to renew a contract requires the execution of a new contract, and does not constitute a present demise; while an option to extend the term is a present demise, extending the term of the original agreement. which then becomes a contract for both the original and extended term.—Helena Light & Ry. Co. v. Northern Pac. Ry. C., 186 P. 702.

PARTIES, PROPOSALS, AND ACCEPTANCES.

(Ga. App.) To constitute a contract, it is essential that the minds of the parties should be in accord as to the same agreement.—Guggenheimer & Co. v. Whitehurst, 101 S. E. 774.

(Mont.) To constitute a contract, the minds of the parties must have met upon the same thing at the same time, or, stated differently, a contract results only from an offer made by one and its unconditional acceptance by another in all its terms. —Koerner v. Northern Pac. Ry. Co., 186 P. 337.

(Mass.) Where a contract was not to become binding until defendant notified plaintiff of his final acceptance, if defendant sent notification of purpose to reject to person to whom plaintiff had chosen to have such notice sent, whether plaintiff received notice or not is immaterial to plaintiff's right of action, and it is also immaterial whether or not the person chosen to receive the notice was authorized to receive it or act upon it.—Massachusetts Biographical Soc. v. Howard, 125 N. E. 605.

(Tex. Civ. App.) Where it is sought to complete a contract by the acceptance of an offer, the acceptance must be in substantial accord with the proposal.—Diamond Mill Co. v. Adams-Childers Co., 217 S. W. 176.

Where in accepting offer there is any material variation or deviation from the terms of the offer, no contract will result; the proposed acceptance becoming a counter proposition, unless the proposer agrees or accedes to the change in terms.—Id.

(Mass.) In an action on a contract, which was not to become finally binding until defendant notified plaintiff of his acceptance, letter of rejection forwarded by defendant to the person indicated by plaintiff to receive it was admissible as evidence to prove defendant notified plaintiff in the manner provided of his election not to be bound by the instrument he had signed.—Massachusetts Biographical Soc. v. Howard, 125 N. E. 605.

FORMAL REQUISITES.

(Iowa) No written contract is complete without delivery, and delivery consists not in a mere nominal act of passing the paper into the hand of another, but the essence of delivery is the intent of the parties, and it is competent for them to attach thereto any conditions upon which they agree.—Herron v. Brontin, 175 N. W. 831.

CONSIDERATION.

(Iowa) To be valid and legally enforceable as between the parties, an agreement or undertaking of any kind must be supported by consideration. —State Sav. Bank of Logan v. Osborn, 175 N. W. 964.

(Mass.) An instrument under seal imports consideration.—Morrison v. Boston Ins. Co., 125 N. E. 698.

(Ky.) The "inducement" for a contract is that which influences the act, while "consideration" means the parting with something by the one from which it moves.—E. F. Spears & Sons v. Winkle, 217 S. W. 691.

(N. Y. Sup.) There is no presumption that a service mentioned in a writing whereby defendant agreed to pay plaintiff a stated sum, which service was rendered without express request, was rendered at the implied request of defendant, and so it is not a sufficient consideration to support the agreement. —Edwards v. Tennis, 179 N. Y. S. 807.

VALIDITY OF ASSENT.

(N. Y.) Ignorance through negligence or inexcusable trustfulness will not relieve party of his contract obligations.—Metzger v. Aetna Ins. Co., 125 N. E. 814, 227 N. Y. 411.

One who signs or accepts a written contract in the absence of fraud or other wrongful act on the part of another contracting party is conclusively presumed to know its contents, and to assent to them, and there can be no evidence for the jury as to his understanding of its terms.—Id.

(Or.) One of the elements respecting a fraudulent statement warranting a rescission of a contract is that the one making it must either know that it is false, or make it recklessly without any knowledge of its truth and as a positive assertion.—Palmiter v. Hackett, 186 P. 581.

(Okl.) Generally a misrepresentation of law affords no ground of relief, the theory being that all men are supposed to know the law, but it is not universally true that such a misrepresentation is not binding on the party who makes it.—White v. Harrigan, 186 P. 224.

Where one has superior means of information, professes a knowledge of the law, and thereby obtains an unconscionable advantage of another who is ignorant and has not been in situation to become informed, the injured party is entitled to relief as if the representation had been as to a matter of fact.—Id.

(Mont.) To constitute a ratification of a contract, there must be an acceptance of the results of the act with an intent to ratify, with full knowledge of all the material circumstances.—Koerner v. Northern Pac. Ry. Co., 186 P. 337.

(Wash.) Generally, a stipulation in a contract that false or fraudulent representations, by which one party has induced the other to enter into it, shall not affect its validity, is itself invalid and cannot operate by estoppel or otherwise.—Normile v. Denison, 186 P. 305.

(Mass.) Fraud is never presumed against a party, but must be proved expressly or inferentially. —Capen v. Capen, 125 N. E. 692.

(Mass.) When there is no apparent reason for one to sign a paper, except the inducement made by false representations, the inference of result from that cause may be made, in the absence of direct testimony.—Capen v. Capen, 125 N. E. 692.

LEGALITY OF OBJECT AND OF CONSIDERATION.

(Conn.) The changing conditions of life modify from time to time the reasons for determining whether the public interest requires that a restrictive contract stipulation be deemed void as against public policy, so that only the present public policy is applicable.—Samuel Stores, Inc., v. Abrams, 108 A. 541.

(Wis.) The validity of a contract is to be determined as of the date of its execution, and a contract, valid when made, cannot be rendered invalid even by legislative action.—Sheffield-King Milling Co. v. Jacobs, 175 N. W. 796.

NEWS OF THE SOCIETIES

May 18-21.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

May 19-21.—INDUSTRIAL RELATIONS ASSOCIATION OF AMERICA. Auditorium Theatre, Chicago.

May 24-26.—NEW JERSEY STATE BUILDING TRADES COUNCIL. Atlantic City, N. J.

June 3-4.—NATIONAL, STATE AND LOCAL ENGINEERING SOICETIES. Organizing conference will be held at Washington, D. C.

June 16-18.—NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual Convention, Asheville, N. C.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada, Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS; Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION; San Francisco. Office of secretary, Boston.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Boston, Massachusetts.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

◆

American Society Civil Engineers.

At the regular meeting in New York, May 5, a paper was presented by Allen Hazen, consulting engineer, on the subject of hydraulic fill dams. It was illustrated by lantern slides and discussed the fundamental problems in connection with the hydraulic method of dam construction, including failures, fine grain versus coarse grain core materials, and the analysis of conditions of stability.

The Southern California Association of members of the American Society of Civil Engineers has voted that whenever the annual convention of the society is held in District 11 it should be held in Houston, Texas.

Engineers' Society of St. Paul.

At a recent meeting of this society a committee report on municipal salaries recommended the adoption of the schedule reported by the committee of the Engineering Council on classification and compensation of engineers, which was adopted. In accordance with this action the City Council has recommended the modification of the present charter provision limiting the salary of appointed officers to $5,000 per annum.

Kansas State Highway Commission.

At a recent meeting conducted by the Kansas State Highway Commission and attended by contractors and material men a committee was appointed to investigate the supply of materials and co-operate with the commission to prevent the award of contracts in excess of the amount of available construction materials. It transpired that the road-building program was much greater than could be provided for by available material and transportation, and that highway construction should proceed as fast as conditions permitted, but should not be forced. The mileage now under construction in this state is about 200 miles.

National Lumber Manufacturers' Convention.

The second annual convention of the American Lumber Congress and of the National Lumber Manufacturers Association was held at Congress Hotel, Chicago, April 22, 23, and 24, with an attendance of more than 200 registered delegates from all sections of the United States. The officers elected were John H. Kirby, president; John W. Blodgett, vice-president; J. H. Bloedel, second vice-president, R. E. Goodman, treasurer, and 12 directors. Chas. S. Keith called attention to several very important reforms needed in this country the first of which were a revision of the Anti-Trust law and a revision of shipping laws.

North Carolina Good Roads Convention.

The North Carolina Good Roads Association, which has a membership of nearly 3,000 distributed through 62 counties, will be held at Ashville, June 16, 17 and 18 and it is expected will be the largest and most important meeting held in the state this year. The secretary of the convention announces the effort to have about 10 per cent of the 52,000 miles of public road in the state included in a hard-surfaced construction state system leaving about 47,000 miles of highways for the counties to construct as feeders to the state highway system which should be increased in the future. Attention is called to the fact that about $36,500,000 a year is spent in North Carolina for automobiles and motor trucks and that their tires have a life five or ten times as long on hard surfaced roads as on unimproved roads.

The Material Handling Machinery Manufacturers' Association.

A number of important committees have been appointed at the recent special meeting of the board of governors of this association; the main engineering committee, F. W. Hall of the Sprague Electric Works, chairman, is composed of the chairmen of the sub-committes on cranes, hoists and winches; gravity and power conveyors; elevators; industrial trucks; bulk handling machinery and miscellaneous equipment.

Several other important committees have been appointed with their chairman as follows: Committee to Co-operate with Technical Societies, chairman, James A. Shepard of the Shepard Electric Crane & Hoist Company; Committee to Co-operate with Trade Associations and Industries, J. H. Flynn, of the Blaw-Knox Company, chairman; Committee to Co-operate with Marine Terminal Commissions, C. A. Luster of the Clyde Iron Works, chairman; Committee to Co-operate with railroads and Railroad Commissions, Francis L. Stuart, of the International Conveyor Company, chairman; Committee to Co-operate with Civic Associations and Governmental Bodies, F. S. Chavannes of the Chesapeake Iron Works, chairman; Special Crane Committee, W. B. Clarke, of Manning, Maxwell & Moore, chairman.

National Highway Traffic Association.

The annual meeting of the National Highway Traffic Association was held in New York, May 13, routine business was transacted and addresses were made by Nelson P. Lewis, chief engineer, Board of Estimate & Apportionment, New York City, on the Effect of the Motor Vehicle Upon the Planning of Streets, by T. A. Aspell, manager truck tire sales department, B. F. Goodrich Rubber Company on Relation of Solid and Pneumatic Tires to Efficient Highway Transport, and by H. Eltinge Breed, consulting highway engineer on the Relation of Tractor and Trailer Traffic to Highway Design.

National Lime Association.

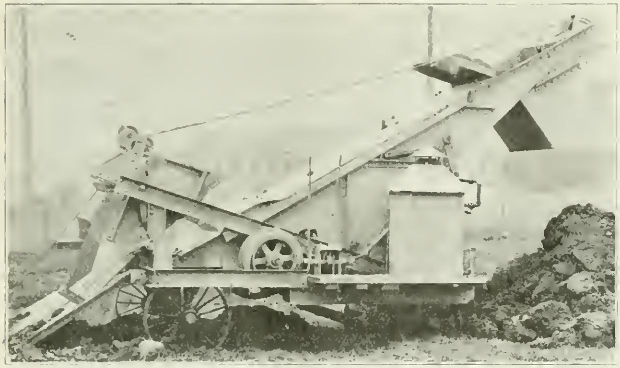
At the next annual meeting at the Hotel Astor, June 17-18, the heavy demand for lime for numerous uses, the critical car supply, and educational publicity will be discussed. The association has recently distributed for comment and criticism, a tentative agricultural lime inspection law proposed for adoption in all states administrating such regulations. It is hoped that this draft may be improved and modified so as to be acceptable to states having such regulations.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

NEW SMITH EXCAVATORS.

The New Model K excavator and loader manufactured by the T. L. Smith Company, of Milwaukee, Wis., is the result of five years of experiments and tests developing a portable dragline filling the big gap between the steam shovel and the expensive gang of hand shovelers



PORTABLE EXCAVATOR AND LOADER OPERATING DRAG LINE SCRAPER BUCKET FROM TOP OF PIT.

Portability is built into the machine, which always stays on the ground level and draws the dirt to it, eliminating the building of trestles which is required for other digging devices which go down into the hole. After the work is finished the excavator can be moved on to the next job as easily and quickly as a wagon.

Only two men are necessary to the operation of this machine, one at the operating levers and one at the loading point. At a point anywhere within 50 to 200 feet from the machine is stretched a chain, at right angles to the line of digging; upon this chain are two sheaves, hooked to the chain. Either sheave may be unhooked and relocated in an instant. One heavy cable passes from the hoist drum on the machine, then to the digging skip, then through both sheaves, back to the retrieving hoist drum on the machine.

The operator at the machine manipulates but two levers and a foot brake. As he places power on the digging line, the other man manipulates the handles on the slip so as to fill it with the material to be dug or removed. The slip has a capacity of 15 cubic feet per trip. As soon as the slip is filled the man releases the handles and allows the slip to ride to the excavator. As the slip strikes the apron at the machine it unlocks the catch of the pivot arm on the machine. The arm then carries the slip up over the machine and onto a slanting chute located on the front of the machine, from where the material in the slip discharges into the waiting wagon, truck or railroad car. The slip is then quickly retrieved to the starting point and the operation repeated.

Chicago Pneumatic Portable Air Compressors.

Bulletin 485 of the Chicago Pneumatic Tool Company illustrates and describes the new class P compressor that has been developed expressly for the contractor, and is rugged, compact and strong as the result of efforts to create a unit combining large capacity with light weight. It has a two cylinder single acting vertical air compressor with 6-inch stroke and valves designed to operate at a speed of 400 revolutions per minute, giving a capacity of 140 cubic feet per minute.

It is driven by a vertical four cylinder gasoline engine having 4¾-inch diameter x 5-inch stroke water jacketed cylinder. The fuel consumption, when operating under a full load, is 25 pints of gasoline per hour, and the engine makes 1,000 revolutions per minute. The engine, compressor and air receiving tank of 10 cubic feet capacity, are mounted on an all steel truck with metal canopy top and canvas sides and ends, which is also equipped with tool box and 20-gallon gasoline tank.

For particularly severe service, class N compressors are recommended and are of portable and semi-portable types operated by oil, gasoline and electricity.

The same manufacturers present the Hummer rock drill equipped with independent motor rotation and a simple, reliable ball valve that gives a very high drilling speed and exceptional ease of operation without vibration or kick back.

The Boyer pneumatic riveting hammers have capacities for ¾, ⅞, 1⅛, 1¼ and 1⅜-inch rivets and strike from 1,000 to 620 blows per minute. Their net weight varies from 20 to 26 pounds.

Lakewood Subgrader.

The Lakewood Engineering Company has put on the market a subgrader that runs on the steel side forms, set to exact profile grade for the road, and is drawn by a road roller. The machine has blades first set to cut about ¾ inch above the required depth, that plane off the high spots and throw the surplus material into two rows. Afterwards the subgrade is rolled and the blades trim it on the second trip to an elevation from ⅛ of an inch to ¼ inch, after which the subgrade is again rolled and the machine goes over it once more, finishing it smoothly to the exact required grade, so that the concrete may be deposited and surfaced up to accurate curve and elevation without any loss of material or irregularities requiring the work to be rejected. It is estimated that in this way the elimination of a subgrade ¼ inch lower than specified profile for an 18-foot roadway will effect an economy of $1,000 per mile.

When it is necessary for other plant to pass the subgrader, which normally occupies the full width of the road, the latter is raised on its turntable, swung parallel with the road, lowered to position on skid timbers and pushed transversely aside sufficiently to give the required clearance, after which it is returned to service by reversing these operations.

Sanitary Sewer Basin Co.

The Sanitary Sewer Basin Co., of Illinois, has opened offices at the above address. They manufacture a patented all-cast-iron sewer catch basin and an adjustable noiseless and lock-cover patented manhole.

Doughboy Jacks.

Doughboy Jacks manufactured by the McKiernan-Terry Drill Company, have been tested by the Bureau of Standards, Washington, D. C., and found to have an ultimate strength of more than twice the rated load on the toe and over three times the rated load on the head. These jacks are strictly portable, easily carried by one man and embody patented features of great practical value. They never back down, never turn around, are guaranteed to lift the rated loads, and are rugged and of simple construction and safe and convenient operation.

DOUGHBOY JACK.

The worm gear is of hardened machine steel; the top is supported on roller bearings between hardened plates; the ratchet box is entirely inclosed to keep the parts in and prevent any possible danger of injury to the operator's hand, and the pitch is such that the jacks will remain elevated under loads for any length of time without backing down a thousandth part of an inch. The entire apparatus is inclosed in a casing of cold drawn tubing electrically welded to the steel head at the top and to the steel step at the bottom. The jacks are made in five sizes, from the 25-ton jacks weighing 70 pounds to the 100-ton jacks weighing 178 pounds. Smaller jacks of similar design are furnished with beveled gears instead of worm gears.

INDUSTRIAL NOTES

Red Strand Hercules Rope.

Hercules red strand, patent flattened strand wire rope is stated by its manufacturer, the A. Leschen & Sons Rope Company, to be used in sizes of 1¼ to 1½-inch diameter for the equipment of most of the large number of drag-line electric excavators now in service on the improvements in the Miami Conservancy District, Ohio.

These machines have heavy scraper buckets up to five yards capacity operated from booms up to 135 feet long, and will eventually have handled most of the 18,000,000 yards of excavation that are required for the dams, river-work, railroad location, etc. The service is heavy and exacting and requires miles of the strongest and most reliable wire rope that is also found to be most economical in the end.

Duplex Truck Service.

The four-wheel drive trucks manufactured by the Duplex Truck Company are credited with satisfactory operation under difficult conditions as set forth in Duplex Doings. One example is that of a Duplex truck operated to serve the Ell Bordo Silver Mine in Mexico where it hauled loads of more than four tons over a mountain road with an average grade of 14½ per cent. and maximum grade of 21 per cent. and having twenty curves in a length of 7,886 feet.

At Griffin, Ga., one of these trucks hauled a three-blade dray machine over 36 miles of road in 8½ hours as against 3½ days when the machine was hauled by a twelve muleteam. In another case a Duplex truck hauled the 29-ton girder of a bascule bridge at North Tonawanda, N. Y. At Trevortown, Pa., a four-wheel drive Duplex truck purchased in 1918 has been operated 9,845 miles with a repair expense of only $16.85.

Maj. H. F. Hackedorn District Sales Manager for H. H. Robertson Co.

The H. H. Robertson Co. announces the appointment of Major Hillis F Hackedorn, recently of the United States Quartermaster Corps, Construction Division, as manager of its district sales office, Penobscot Building, Detroit. During his service in the army Major Hackedorn had charge of construction work at the Frankford Arsenal, Philadelphia, and the United States Government picric acid plant at Brunswick, Ga. Before entering military service he was engaged independently in extensive engineering and construction work.

Major Hackedorn is by virtue of his long and varied engineering experience well qualified to advise in regard to the use of Robertson process metal for roofing, siding, ventilators and skylights and other Robertson process products.

Bayles, G. H., has accepted a position as chief engineer of construction of A J. Krebs Company, builders, Atlanta, Ga.

PERSONALS

Gladding, Captain James N., has accepted the position of city manager of Albuquerque, N. M.

Parker, C. J., has been made chief fire protection engineer of the New York Central Railroad.

Mullekin, Alfred, has been appointed assistant sanitary engineer, New York State Department of Health.

Meikle, R. V., has been appointed chief engineer in charge of construction of the Don Pedro dam and power plant for the Turlock Irrigation District, California.

Very, E. D., has been appointed first assistant engineer, Bureau of Street Cleaning, Philadelphia.

Jones, P. F., has been appointed assistant engineer for the construction of the Don Pedro dam, Calif.

Collins, William, has been appointed city engineer of Decatur, Illinois.

McAuliffe, P. J., has opened an office as consulting engineer in New York City.

Whitner, H. F., has been appointed division engineer of highways at Blueridge, Ga.

Greenslade, William, has been appointed engineer of the Tenth Congressional District at Augusta, Ga.

McWhorter, A. W., has been appointed engineer of the Eleventh Congressional District at Waycross, Ga.

Calkins, A. S., has been appointed city engineer, Joliet, Ill.

Lough, Thomas, has been appointed assistant state engineer of North Dakota.

Firth, Joseph, has been appointed city manager of West Palm Beach, Fla.

Hamm, R. C., has been appointed engineer of Ford County, Kansas.

Kidd, Herbert L., has been appointed city manager, Kingsport, Tenn.

Murray, J. A., Jr., has been appointed principal assistant engineer, Bureau of Engineering, Albany, N. Y.

Spooner, J. P., Jr., has been appointed assistant engineer San Joaquin Company, California, in charge of highway maintenance.

Pearson Roderic has been transferred to the Missoula (Mont.) office of the U. S. Bureau of Public Roads.

Schreiner, W. R., has been appointed engineer of Summer County, Kansas

Goldberg, L. I., state engineer of Michigan Highway Department, has resigned to engage in contracting at Traverse City, Mich.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, MAY 22, 1920 No. 19

SEWAGE SCREENING AND PUMPING STATION, DAYTONA.
Water works tank and pumping station in the background.

Sewerage of Daytona, Florida

The sewage from maximum population of nearly 18,000 pumped at main and secondary stations by centrifugal pumps and compressed air ejectors, screened and disinfected by a plant that cost $142,000.

Daytona, Fla., has a population of about 7,500 in summer, with 3,000 to 10,000 visitors in winter. It is sewered throughout a large part of its area, although 500 residences (mostly occupied by negroes) are served by the can system. The cans are collected by the city and the contents emptied in the woods about two miles from the occupied section; but arrangements are being made for emptying them into the sewer near the sewage treatment plant.

Although the water department furnishes about 275,000 gallons of water a day, about 900,000 gallons pass through the sewage plant after rains, and much less at other times. This is believed to be owing to poor joints in the sewers and to the discharging of roof water into them, although this is forbidden. In addition, there is more or less hard, sulphur water used from private wells instead of the city's softened supply.

PUMPS.

The city is very flat and it is impracticable to discharge the sewers into the river by gravity. The sewer lines begin at a depth of about 5 feet and the mains fall until a depth of about 11 or 12 feet is reached, when the sewage is lifted about 6 feet and again flows by gravity. All of the sewage flows to a main pumping plant, although about half of it does not have to be lifted at secondary stations. In all there are about 21 miles of sewers from 8 inches to 24 inches in diameter, about 16 miles being of the former. An iron outfall sewer 12 inches in diameter and 10,600 feet long carries the sewage effluent from the main pumping station to a point in the river channel below the city. Both automatic and semi-automatic flush-tanks are used.

EJECTORS.

The secondary lifting is done by means of fourteen Shone ejectors in seven stations, the two appliances at each station being intended to operate alternately. The only trouble in operating these has been due to large pieces of old cloth, dead dogs and other large objects which occasionally find their way into the sewer. There is apparently no loss of air from the pipes that bring air to the ejectors from the compressor at the central station.

Compressed air is furnished by a compressor of the Bury Compressor Company with a capacity of 150 cubic feet per minute. Air is kept at 16 to 20 pounds in the air tank. An additional compressor has just been furnished by the Chicago Pneumatic Tool Company, but has not yet been put into service. The compressors and main pumping plant are operated by a De La Vergne oil engine of 50 horse-power, making 210 r.p.m. Use of an oil reclaimer of the same company makes it possible to use the oil repeatedly with but little loss.

SCREENING AND DISINFECTING.

On reaching the pumping station but before being pumped into the outfall sewer, the sewage passes through an R.W. screen 8 feet in diameter, with 5/64-inch slots and a solid cone. The screenings contain little foecal matter and are only slightly offensive. They are emptied at the same place as is the night soil, but it is hoped that an incinerator may be installed to burn the screenings and the city's refuse. Forty-one cans, about the size of a fairly large ash can, of screenings were removed by this screen in January and 54 in February. In the summer about 30 cans a month is the average. The cans are raised from the screen pit to the wagons by a chain block.

In addition to being screened, the sewage is disinfected by means of a Wallace & Tiernan liquid chlorine apparatus, applying 20 pounds per million gallons of sewage. This is done chiefly because of the oyster plantings in the river into which the sewage is discharged.

The clarified effluent is forced through the iron outfall by two centrifugal pumps of 2,000,000 gallons capacity each and one of 1,000,000 gallons.

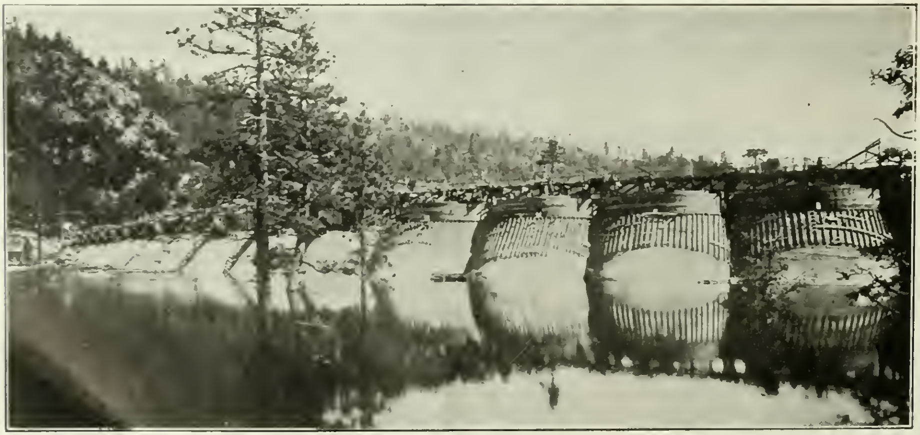
Last year the expenses of the city for sewerage included $225 for carting screenings, $783 for chlorine, $4,886 for sewage collection and disposal, $783 for sterilization, $526 for air service. For depreciation and interest on bonds, $12,462 was charged. The collecting system was valued at about $86,000; air equipment, $15,750; sterilizing equipment, $1,258, and disposal equipment, $39,550.

Lake Eleanor Dam

The Lake Eleanor Dam in the Hetch-Hetchy water supply system for San Francisco was completed during the fiscal year ending June 30, 1919, and is briefly described in the annual report of city engineer M. M. O'Shaughnessy just issued. The purpose of the dam is to impound water to operate a hydro-electric plant of 4,000 h. p. capacity which will drive the machinery required for the construction of the main Hetch-Hetchy dam and the aqueduct tunnel, as described in articles in Public Works of March 6, page 165; March 20, page 203, and March 27, page 234.

The dam across the outlet of Lake Eleanor, 4,660 feet above sea level, is located at the site of a future higher dam, of which it will eventually form a part, when it will serve for impounding a supplementary supply to that furnished by the main dam.

In general plan, the dam is arched or pointed upstream, and has twenty arch units of 40 feet span and a straight gravity wall containing 200 feet of spillway sluices. The total length and height



DOWN STREAM VIEW OF 40-FOOT ARCH UNITS IN ELEANOR DAM NEARLY COMPLETED.

are respectively 1,260 feet and 70 feet. It was built entirely by day labor by methods described in the March 20 article. Since the publication of this article, additional photographs have been received and are here reproduced to show the general appearance of the finished structure designed with a comparatively small mass of concrete to withstand a considerable pressure head, and to show the forms and service track for concreting the multiple arches. (One of these photographs will be found on the front cover of this issue.)

$15,000,000 Niagara Power Plan

A bill has been prepared for presentation to the New York State Legislature providing for a bond issue of $15,000,000 that will necessitate a referendum next fall. If successful, this will enable the state to proceed with hydro-electric developments in the Niagara Gorge calculated to generate 165,000 h. p. and relieve industries in the western part of New York State. It is thus hoped to regain control of valuable privileges that have been relinquished by the Legislature since 1890, many of which have, however, remained unproductive. The program proposed by Conservation Commissioner Pratt, provides for the restriction of diversion rights, for the limitation of diversion rights at Massena and the Little Sault on the St. Lawrence River, with ultimate developments there, and for amendments to the Constitution in carrying the development and transmission of hydro-electric power for public use that will be possible within and across state forest reserves and for state regulation of stream flow by storage reservoirs.

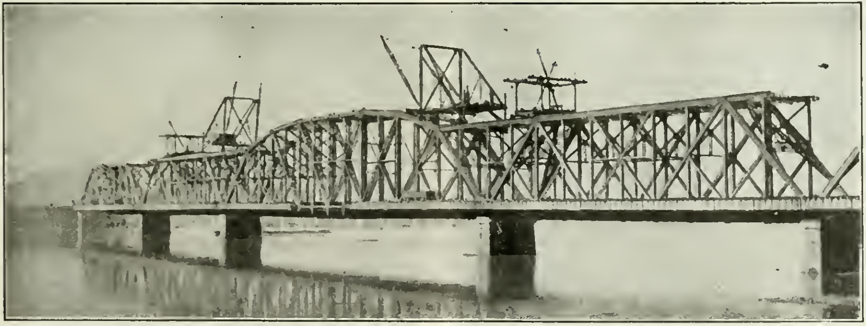
Hydro-Electric Plan for Dead Sea

A plan to utilize the difference in level between the Mediterranean and the Dead Sea for the development of hydroelectric power has recently been brought forward. A tunnel 37 miles long from the Dead Sea valley would give a drop of 1295 feet for power generation. The power would be used for lighting and industrial purposes in the Holy Land, and to pump water from Lake Genezareth to irrigate the Jordan valley and the plain of Sharon. It is claimed that with regulating dams at Genezareth, there is enough water to irrigate several thousand acres.

Kenova Bridge Channel Span Erection

Cantilever erection of 518-foot center span outside of old span under traffic. Adjacent anchor spans moved longitudinally and heavy girder ties shortened for erection adjustments. Complicated floorbeam replacement. Center panel erection connections adjusted by jacking up ends of connected spans.

The single track superstructure of the five span bridge of the Norfolk & Western Railway Co. over the Ohio River at Kenova, West Virginia, has been replaced with a new double track superstructure, on the old substructure, without interrupting traffic. On account of the height of about 100 feet above the water, the imminence of very high floods, the long distance to any other railroad crossing of the river, and the necessity of preventing serious interruption of traffic or navigation, the work was necessarily slow and costly and presented many difficulties that were eventually overcome by a



ERECTION OF CENTER SPAN COMPLETED. LARGE TRAVELERS RECEDING FROM THE CENTER TO BOTH ENDS AND REMOVING CANTILEVER SERVICE TRACKS AFTER REMOVING OLD SPANS.

somewhat elaborate and unusual plan of erection involving different methods for the end and intermediate spans.

The trusses for the end spans were erected on their own floor beams temporarily suspended from the old trusses while the traffic was carried on the old track supported by falsework as described in Public Works, April 24, page 345.

The two adjacent spans, also 298 feet long, were erected from their shore piers as full length cantilevers enclosing the corresponding old spans and finally lowered to bearing at their river ends on the channel piers as described in Public Works, March 27, page 237.

The erection of the 518-foot channel span was also accomplished by the cantilever method both ends, enclosing the old span, being simultaneously erected from the channel piers, 3 and 4, using the adjacent 298-foot new spans for anchorages. The trusses are 91 feet deep and 43 feet apart on centers with riveted connections at panel points excepting the four center panels of lower chords which are pin-connected eyebars. The top chords are horizontal in the four center panels and inclined at both ends; the weight of the span is 3,354 tons.

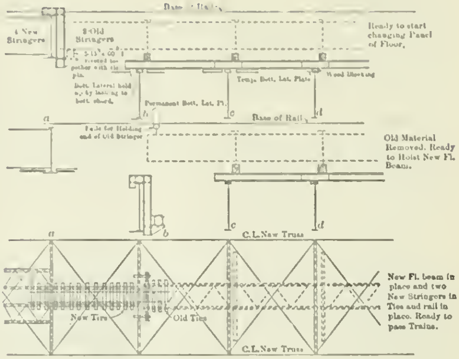
ERECTION OF TRUSSES.

The small mule travelers used for the erection of the end spans, that were illustrated and described on page 238, March 27, were placed on the top chords at the shore ends of the adjacent spans 2 and 4, where their weight was supplemented by rails also used on the erection of these spans to give additional counterweight for the anchorage of the channel span. The small travelers removed the erection ties that had connected the end and intermediate spans and portions of them were re-erected on the channel piers, 2 and 4, to serve for the anchorage of the cantilever ends of the channel span.

In order to provide for erection compression in the bottom chords and for temperature contraction, the expansion end of the span was located 6 inches south of its final position and the south end of the adjacent 298-foot span 4 had been correspondingly displaced to insure an overlap of 1 inch of the bottom chords in the center panel and facilitate final connections there.

The duplicate 212-ton overhead mule travelers used for the erection of the adjacent spans 2 and 4 were brought forward on them to the river end of their top chords and commenced erection of the trusses with their 105-foot inclined end posts that with shoe and pin attached weighed 105 tons each. Each end post was lifted by the two 65-ton booms of the traveler that for this purpose were equipped with a balance beam attached to the inclined post in such a manner as to hoist it in an inclined position. The end post was lowered until the shoe took bearing on the pier and the post was maintained in position by temporary eyebars connected to the center point and to the top of the temporary vertical posts on the pier that supported the erection tie, thus permitting the release of the derrick booms.

The truss members and other materials were delivered to the travelers on service tracks carried outside the new trusses on temporary cantilever projections from the end of the new floorbeams.


Base of Rail
4 New Stringers
2 Old Stringers
Ready to start changing Panel of Floor.
Temp. Bott. Lat. Plate
Wood Blocking
Bott. Lateral held up by lashing to bott. chord.
Permanent Bott. Lat. Pl.
a
b
c
d
Base of Rail
Bolts for Holding end of Old Stringer
Old Material Removed. Ready to Hoist New Fl. Beam.
C.L. New Truss
New Ties
Old Ties
New Fl. beam in place and two New Stringers in Ties and rail in place. Ready to pass Trains.
C.L. New Truss

SEQUENCE OF OPERATIONS IN REPLACING OLD FLOOR BY NEW, UNDER TRAFFIC.

When the end posts were erected these tracks had been installed only as far as the channel piers and, in order to bring the floorbeams within reach of the traveler booms, track extensions were supported on two temporarily lengthened new floorbeams suspended from the end floorbeams of the old center span so that their end brackets could carry the stringers and service tracks which were later transferred to the floorbeams of the new channel span. In order to carry the excessive load of the heavy end posts and their cars, the connections of the brackets to the end floorbeams were supplemented by 3-inch horizontal tension rods connecting the brackets at both ends of the beams.

As the erection progressed the travelers advanced over the horizontal erection ties and mounted the inclined top chords of the center span. The traveler weighing 423,000 pounds was hauled up the incline by three sets of 6-sheave steel rope tackles supplemented by three sets of 4-sheave Manila rope tackles provided in case of emergency, and all anchored to the top of the old span 3. In each position of the traveler brackets were bolted to the top chords behind the traveler and the tackles were slacked off to permit the traveler to bear against the brackets which maintained it in position during service.

FINAL CONNECTION.

After all the truss members were erected and assembled there remained in the center panels of both trusses open connections in the top chords, at one end of a horizontal intermediate strut, at the top of a sub-vertical, and at the bottom of a main diagonal. There was an opening of 10 inches between the ends of the adjacent top chord pieces and the bottom chord eyebars being too long were deflected several inches from the horizontal line and were subjected to tension of about 240,000 pounds. The lower end of the main diagonal overlapped the connection about 6 inches, and as the bottom chord was deflected 45 inches downwards, the upper end of the sub-vertical was 45 inches below its final position and was held in place by a bolt moving in slots allowing for a displacement of 4 feet.

Jacking girders were attached to the shore ends of the adjacent spans and were operated to lift them and bring the open joints at the center panel of the main span into register. During this operation, span 4 moved about 6 inches longitudinally, a displacement that had been provided for by placing the jacks on a roller carriage moving on top of the pier.

The jacking was continued after the ends of the top chords engaged until the bottom chords straightened and the sub-vertical at the center point moved upwards until the connection at the top could be made as well as the connection at the bottom of the main diagonal and at the ends of the center longitudinal strut.

Jacking was continued until the stresses began to reverse and eventually all tension was eliminated from the erection ties and all three spans were acting independently. This operation took about 7 hours and involved a total jacking of about 45 inches. After the main span adjustments were completed, the adjacent spans were lowered to their final positions on the piers and traffic was resumed after an interruption of 11 hours.

10" Gap in top chord Span 3
before closing span.

MAKING FINAL CONNECTION IN CENTER PANEL OF TOP CHORD.

Longitudinal I-beams were placed on top of the floorbeams of the new span, the old span was wedged to bearing on them and the old trusses and old bracing were removed.

SHIFTING TRACK.

The old floor panels were successively replaced by new beams and stringers by parties working from both ends who just jacked the old floor longitudinally if necessary to make the old stringers clear the flanges of the new floorbeams. The new stringers previously used in the outside material tracks were suspended between the trusses and the old stringer and floorbeam connection rivets were replaced by bolts. The laterals were suspended and their temporary connection plates removed.

The track rails were disconnected and longitudinally hauled clear of the panel and the worthless old ties dumped in the river. The next panel of old stringers was suspended from sway bracing and the old floorbeam disconnected and temporarily suspended from sway bracing. The new floorbeam was disconnected from the bottom chords which were jacked apart and bolted to floorbeam with filler plates inserted.

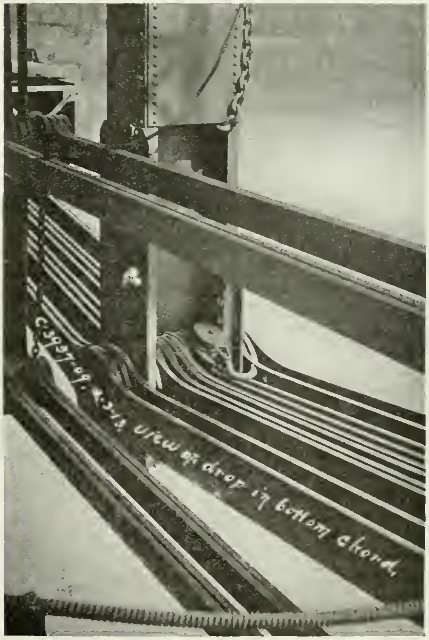
The two stringers temporarily suspended between the trusses were connected to the floorbeam and the latter was finally adjusted in proper position and service bolted to carry trains. After traffic was resumed, the stringers for the other track in the same panel were erected and the bottom lateral system assembled and connected. The interruption in train service for each panel varied from 55 to 90 minutes, and the whole floor was changed in 7 weeks notwithstanding a delay of two weeks due to an injury to one of the travelers. After the old floor was entirely removed, track was laid on the other pair of new stringers and traffic diverted to it, permitting the track to be laid on the first pair of stringers.

The bridge was designed, fabricated and erected by the American Bridge Company, C. W. Bryan chief engineer, C. G. E. Larsson, assistant chief engineer, who devised the general construction method, W. G. Grove and Henry Taylor, assistant engineers. The diagrams illustrating this article are reprinted from a paper by W. C. Grove and Henry Taylor, published in the Transactions of the American Society of Civil Engnieers, Volume 79, page 411..

Rapid Repairing of Baltimore Pavements

The highways engineer of Baltimore, Md., August E. Christhilf, has completed the development of a plan whereby all the streets in the old city will be repaired in 60 days, the plan having been recently submitted to and approved by the Board of Estimates.

The old city has been divided by Mr. Christhilf



CENTER PANEL BOTTOM CHORD PREVIOUS TO FINAL ADJUSTMENT OF CENTER PANEL OF TOP CHORD.

into three zones, the first of which has been assigned to the American Paving Company, the second to P. Flanigan & Sons and the third to the Baltimore Asphalt Block and Tile Company.

For this repair work the three contractors will be paid on the square yard basis, the Board of Estimates having decided that this method of doing the work will be much better than the proposed "cost plus" plan, at the same time assuring the hurried completion of the repairs.

At an estimated cost of $300,000, the State Roads Commission will resurface with sheet asphalt the main thoroughfares of the New Annex. This work will be paid for out of the city's share of the State Roads Fund.

Water Consumption in New Bedford

During the year 1919 the water consumption in New Bedford, Mass., averaged 78 gallons per capita, which was 4 gallons less than the year previous. Of this, 26.7 gallons per capita was used by domestic consumers, 39.7 by manufacturing consumers, about 0.8 gallon was used in cleaning the reservoirs, and the balance, or 14 per cent. of the total consumption, was used for flushing mains and extinguishing fires, leakage and unaccounted for. In 1899 the consumption averaged 107 gallons per capita, and diminished from this to 69 gallons in 1914, after which it rose to 82 gallons in 1918. Meantime the number of meters increased from 734 in 1898 to 15,019 in 1919.

Road Bulletin for Massachusetts

Commissioner John N. Cole of the Massachusetts Department of Public Works is making plans for issuing a road bulletin service for the benefit of motorists and truckmen. It is his intention to have information gathered every week as to the condition of the principal motoring routes throughout the state, with data concerning detours, road construction and the like, and to issue it regularly in bulletin form.

Last fall the United States Weather Bureau inaugurated a highway weather service which covered the condition of roads in New England with particular reference to the weather. As the roads are little affected by weather during the summer months and the Weather Bureau did not regard it as within its province to continue the service for such things as construction obstacles, the service has been discontinued till fall.

East Cleveland Zone Ordinance Upheld

The city of East Cleveland, a suburb of Cleveland with a population of about 30,000, adopted a building zone plan for the city in July, 1919. Four zones were established, an unrestricted industrial zone, a business zone restricted against manufacturing of all kinds, an apartment house zone restricted against manufacturing and business, and a private dwelling zone restricted against manufacturing, business and apartments.

Following the adoption of this ordinance, the building inspector refused to issue a permit for the erection of eight apartment houses in the private dwelling zone. The case came before Judge Foran, who sustained the validity of the ordinance. The case was not fully argued before him, and no evidence was submitted by either party, and a re-hearing was granted which came before Judge Kramer. Here evidence and arguments were submitted by the city, but substantially no evidence was given by its opponent. Judge Kramer on April 30 rendered his decision, "First, that the ordinance here in question is a valid exercise of the police power by the city of East Cleveland, under the authority of its charter; second, that it has not been shown that the classifications made under this ordinance are unreasonable, arbitrary, discriminatory and not uniform in operation." The petition was therefore dismissed.

The Judge, in sustaining this decision, stated that there could be no two opinions upon the proposition that the apartment house or tenement in a section of private residences is a nuisance to those in its immediate vicinity. While the erection of one apartment house in a district may seriously affect only a few in its immediate vicinity, it is common experience that, when one apartment has been erected, the whole street will soon be given over largely to apartment houses. The apartment house is for many a desirable convenience and for some a necessity; their erection should not be prohibited, and under the ordinance is not prohibited, but they are merely restricted to certain defined areas. No owner of property should be permitted to so use his property as to detract from the value of that of his neighbors when the demand or necessity for such use can be met equally well by the use for this purpose of property in other locations.

Yonkers Zone Ordinance

On April 15 the Zoning Commission of Yonkers, N. Y., held a public hearing on a tentative zoning ordinance, in the preparation of which Herbert S. Swan served as consultant to the commission. The ordinance is divided into six articles, the first giving definitions of the terms used, the second specifying the use districts, the third the height districts, the 4th the area districts, while the 5th provides for a board of appeals and the 6th is general and administrative.

The use districts are given as residence, business, industrial and heavy industrial. Residence districts are restricted to certain uses named, including boarding houses, hotels, churches, schools, hospitals, truck gardening, private garages, etc. In defining business district, the ordinance names the uses for which no building in the district can be used, and the same is true of the industrial districts, from which are excluded the manufacturing of asphalt, brick, gas, iron, rubber, etc., or "any other trade, industry or use that is noxious or offensive by reason of the emission of odor, dust, smoke, gas or noise." Residence and business uses are not excluded, and no uses are prohibited in the heavy industrial district which are permitted in any of the others. As the heavy industrial district prohibits a number of trades and industries which are offensive by reason of the emission of odor, it apparently follows that these are prohibited anywhere within the limits of the city.

Height districts are divided into four classes:

35-foot, 50-foot, 75-foot and 100-foot; with the usual exception granted to church spires, towers, chimneys, etc.

A board of appeals is established consisting of five members appointed by the mayor for a term of three years, which may, after public notice and hearing, determine and vary the application of the regulations in harmony with the general purpose and intent of and within limits specified in the ordinance. If an appeal to the board fails to receive four votes in its favor, this will be deemed as denying the appeal.

Granite Block on Old Concrete Base

Repaving part of Park Avenue, New York, for heavy traffic, with granite blocks replacing asphalt blocks on the original base. One illustration.

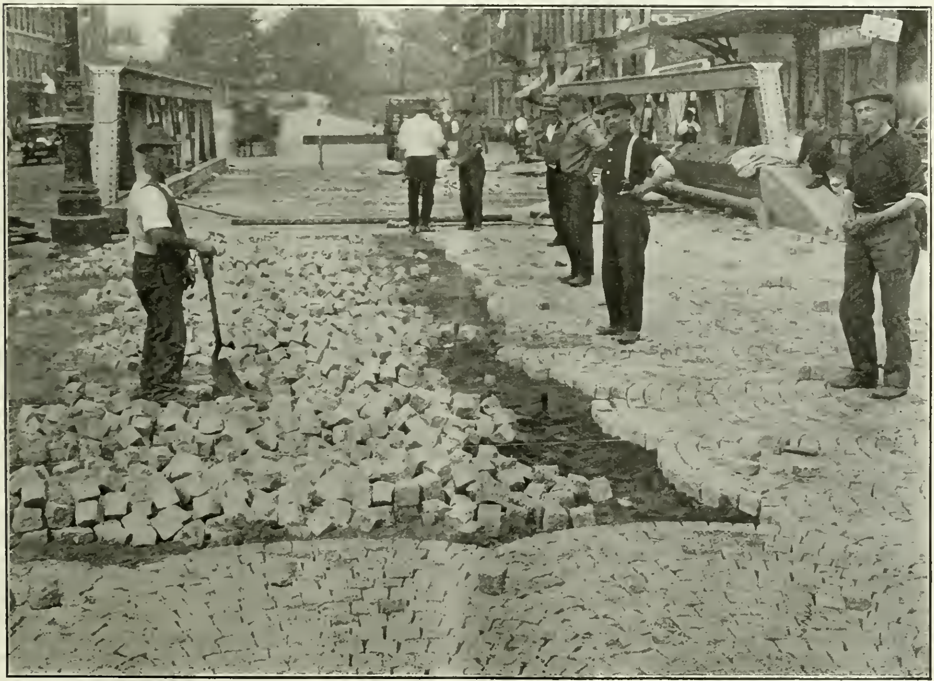
From Clairmount Parkway to Tremont Avenue, a distance of about seven blocks, Park Avenue, New York, was repaved last fall by J. Leopold & Co., Inc., with a granite block surface, replacing an asphalt block surface on the original, undisturbed concrete base. The street here is about 33 feet wide. The area covered amounted to about 15,000 square yards and was executed in about 75 calendar days.

Operations were commenced by a gang of 15 men with pinch bars, removing the old blocks and loading them into automobile trucks, by which they were immediately hauled to the dump and there wasted, since they had no commercial value.

About 200 or 300 feet in the rear of this stripping gang, there followed the cleaning gang of five men who, with picks and shovels, removed the ½-inch mortar bed from the old concrete surface, loaded it into the trucks to be hauled away and thoroughly washed the surface with hose and stiff splint push brooms.

The stripping and cleaning of the seven blocks occupied about three weeks and was executed at intervals corresponding with the paving of each block as a separate operation, completed before the next block was commenced, so that the heavy traffic was diverted from only one block at a time.

A mortar gang of 8 men with hoes carefully blended 3 parts of clean sand with 1 part of Portland cement to make the ¾-inch thick cushion carefully spread over the concrete about 10 feet in advance of the pavers. Sand and cement delivered in automobile trucks were stored on the street, the



LAYING NEW GRANITE PAVEMENT BLOCKS ON OLD CONCRETE BASE IN PARK AVENUE, NEW YORK.

cement bags being protected by small movable houses of about 500 bags capacity.

As fast as the cushion was prepared, the pavement was laid by a 12-man gang at the average rate of about 300 yards in one 8-hour shift.

The granite blocks were of the Durax type, which consists of cubes from 3 to 4 inches square, laid in concentric circular arcs so that none of the principal lines of joints parallel the traffic, a feature that is considered to greatly improve the smoothness of traffic and the durability of the surface. The blocks are intentionally varied in size to enable them to meet this style of arrangement.

The blocks were rammed to the required street crown and compacted by a roller of 2½ tons weight or more.

The pavers were followed by the grouting gang, which filled the joints with cement grout mixed in a Koehring steam-driven grouting machine and thoroughly broomed over the surface.

The different operations followed each other continuously and systematically, completing the work at the rate of about 1 block per week and not involving the closing of any part of the street for more than 10 days.

The retention of the old concrete base, which was found to be in satisfactory condition, expedited the work and secured an economy estimated at from $2 to $3 per square yard.

The use of the small Durax blocks permitted the replacement of a worn, shallow pavement without raising the grade or disturbing the foundation. It has proved so satisfactory that there are now under construction in the Borough of the Bronx about 15,000 yards of this pavement which are to be completed in 1920.

Since the completion of the work above described the cement joint filler has been superseded by a bituminous filler composed of equal parts by volume of clean sand passing through a 10 mesh sieve, heated to a temperature of between 300 degrees and 400 degrees Fahrenheit, and mixed with an equal volume of paving cement at a temperature of from 325 to 400 degrees Fahrenheit.

In practice about 2½ cubic feet of hot asphaltic cement is poured into a concrete carrier pushcart of 7 cubic feet capacity, the hot sand is added to it and the mixture thoroughly stirred with a rake or perforated hoe and promptly flushed into the joints until the container is emptied before a new batch is prepared. Sufficient men and apparatus are required to pour all the joints of the pavement the same day that they are laid, after which the surface is covered with coarse, dry, hot sand.

This pavement is intended to sustain a very heavy traffic, under which it is stated to have given good satisfaction in this country for 8 years and in Europe for about 35 years.

Labor conditions that are unfortunately typical of many parts of the country are reported from the Pittsburgh district, where carpenters receiving 87c per hour struck for $1.12½ and were offered $1, with the request that they wait until the Pittsburgh scale had been signed, in reply to which they immediately withdrew their offer and, without warning, 400 struck for $1.25.

Reinforced Concrete Highway Bridges

Details of design, specifications and construction which should be studied with a view to developing and standardizing practice in this branch of highway work, as proposed by the chairman of a committee of the American Concrete Institute.

The American Concrete Institute has, as one of its committees, one on reinforced concrete highway bridges and culverts. This committee at the recent convention reported progress, but this was more than the perfunctory "progress report" which so often means that nothing has been done by a committee during the year. On the contrary, the chairman of the committee, A. B. Cohen, has had drawn up a quite elaborate outline of the work which it seemed desirable for the committee to adopt as its program of work during the coming year or years. In fact, in a letter to this journal Mr. Cohen admits that the work is so comprehensive that it is almost certain the committee will not be able to cover it in full for the next convention, but it expects to get under way in an attempt to "place concrete bridge construction on a more uniform basis, comparable with the uniformity found in structural steel work."

This outline of what is proposed is divided into the several main heads of "Recommended Practice," "Assumptions in Design," "Specifications" and "Methods of Construction." Under the head of "Recommended Practice" are considered architecture, construction joints, curbs, clearances, devices, drainage of floors, expansion joints, electrolysis, fill over arches, foundations, preliminary study and investigation of bridge site, paving, plans, reinforcing steel, types of bridges, water-proofing and piers and abutments. "Assumptions in Design" are considered under the head of arches, weights of material, load assumptions, load distribution, impact, design of slab of T beams, earth pressures, designs of forms and faulty design. Under methods of construction are considered arch construction, removal of forms and chuting concrete.

RECOMMENDED PRACTICE.

It is considered that in designing concrete bridges, since they are to have long life and since "Concrete lends itself to a most graceful and admirable form of architecture," respect should be paid to architectural features, it being the experience that tax payers are willing to pay a little more for improvement in appearance.

"Construction joints" is believed to be one of the most important questions in concrete bridge design. No bridge plan is complete without showing the location of every possible construction joint, involving the daily capacity of an average mixing plant, so that the contractor will know the intention of the design beforehand and be prepared to regulate his work accordingly. Recommendations should be made dealing with construction joints of large and small arches built on either normal or skew span, for horizontal joints in mass work, for joints in rectangular and T beams, in slabs, etc.

Where a pier or retaining wall is of such height as to necessitate horizontal construction joints, the rusticated or grooved joint has been used to good advantage in place of irregular, unsightly joints.

The lengths of the reinforcing rods should be so determined that only a sufficient amount for proper bonding should project beyond the construction joint. (The Chairman has a photograph showing rods extending at least 35 feet vertically above the top or skew back of a pier in arch construction.)

Curbs of bridges should be higher than in ordinary street work, because of the danger that a vehicle, if it should amount onto a sidewalk, might crash through the railing; moreover, there is no necessity for pedestrians to leave the sidewalk for the roadway or vice versa.

There should be adopted standard vertical and lateral clearances for steam and electric railways.

It might be advisable to give some space to devices that have proved their worth in simplifying construction, such as form ties and spacers, bar cradles and hangers, wire mesh, etc.

Drainage is so inter-related with expansion joints, water-proofing and construction joints that all these must be considered jointly in a successful design of a floor system. Water must be carried off the floor in as many places and as quickly as possible. Down spouts should not be placed in concrete sections without due regard for expansion of the metal drain pipes. Drain outlets should not be placed where the drip will pour over a concrete surface or where icicles forming overhead will endanger life. Drainage of abutments and retaining walls by French drains and weep holes should be considered.

Expansion joints are as necessary in concrete construction as in steel. How far apart they should be placed to work effectively in the various types of concrete design, in floors over arches, spandrel walls over arches, T beam or rectangular beam or slab construction, in flat slabs, retaining walls, abutments, etc., should be determined. Also the respective merits and defects of the various types of expansion joints, viz., sliding, rocker and cantilever joints. For the sliding joints, steel, copper and bronze plates and asphaltic membrane have been used with varying degrees of effectiveness. A complete break in structure by an arrangement of a double row of columns, depending upon the flexure in the column to take up the movement due to temperature changes, has proved very effective. The chairman believes that sliding joints should be discouraged on account of their uncertainty. A slight settlement or irregular construction may cause friction on a sliding joint which has greater resistance than the vertical section of a particular member in shear, which results in an unsightly and dangerous crack near the expansion joint.

In spandrel floors over arches, a vertical joint in the floor slab formed by cantilevering slab from spandrel or cross walls has proved very effective, since by this arrangement the vertical movement of the floor, due to rise and fall of the arch ring and the horizontal movement of the floor system itself, are well taken care of.

Consideration should be given to the precautions to be taken when arches and culverts are placed under deep fills, to prevent overflow of the embankment over head-walls and wing-walls. It is believed that the slope of the embankment will vary with different heights of fill.

For foundations, the soil should be tested for each particular bridge, but to provide for cases where this is not practicable, a classification of the various soils should be made, and the bearing power of each class determined.

In connection with reinforcing steel, bending diagrams and a thorough list of all bars should be shown on the plans. Consideration should be given to the best form of stirrups, to the minimum spacing of bars in beams, and to the protection of stubs exposed during winter weather.

Bridges should be classified, giving the type best suited for various general conditions of span, length, width, foundations, etc.

Waterproofing systems can be divided into two classes—membrane and integral. For the former either felts, papers, or cloth, or a combination of these materials, is generally used. Mr. Cohen does not believe that any of the numerous integral methods on the market are applicable to any degree for water-proofing bridge floors susceptible to cracks. A water-proofing membrane should be protected and made more durable by covering it with asphaltic mastic, a layer of brick, or a two-inch layer of concrete. Bituminous pavements should not be laid directly on the membrane.

How should piers and abutments in streams be protected against scouring action of the water? Are piers in roadways a menace or a help in safeguarding traffic?

ASSUMPTIONS IN DESIGN.

What range of temperature should be considered in designing arches for the various climatic zones? Does the present accepted formula give values in excess of those that actually exist? (Bulletin 30 of Iowa State College by C. S. Nichols and C. B. McCullough, describes the first effort known to the chairman for determining actual temperature changes and effects).

Load assumptions should be made for trucks and traction engines and electric traction loading, the latter being classified by weight in increments of five tons for both city and interurban cars, giving the spacing of wheels and truck centers. A compilation should be made of the laws passed by all the state legislatures regulating or limiting the weights of vehicles.

The 1919 report of this committee relative to the distribution of concentrated roads over simple rectangular slabs, over a series of T beams, over slabs superimposed on steel I beams, over arches distributed through various depths of fills, and on floor slabs and girders of a through girder bridge, are not considered conclusive but open to wide discussion and further investigation.

Consideration should be given to the allowance to be made for impact, whether this be by adopting a loading in excess of the actual loading, or by using the actual loading and adding a factor depending upon the length of span or dead load.

Special study should be made of the theoretical and practical considerations involved in the designing of the slabs of T beams.

Data are needed on the subject of the pressure of earth against retaining walls and whatever data are available should be collected and the tests already made should be enlarged upon.

The subject of pressures upon forms and unit stresses in the forms themselves should be looked into.

It might be advisable to tabulate some of the mistakes that have been made repeatedly; for example, timber grillage constructed above water-level to support masonry piers or abutments, tendency to use empirical formulas in designing walls and abutments, the use of wide differences in sections of wing walls and abutments at the junction of the two, placing foundations above frost line, lack of proper drainage of retaining walls and abutments.

METHODS OF CONSTRUCTION.

Under this head would be discussed the various types of arch centering, methods of constructing arches by voussoirs, methods of constructing skew arches, time for removing forms under variable conditions of temperature, etc. Concerning the last it would seem that a more scientific analysis leading to definite regulations could be developed on the basis of existing data, of which some very important illustrations can be found in a paper by Professor A. B. McDaniel, before the 1916 convention of the Institute.

Chuting concrete has developed so rapidly and with such success that many abuses of the system exist, which the committee should ferret out and prohibit in proposed new specifications.

Disposal of Municipal Wastes

By Joseph Goder *

The author discusses the several methods of disposal, giving his reasons for concluding that incineration is decidedly preferable for some classes of waste in all cases and for all classes in some cases. The interrelation of collection and local characteristics of the several classes of waste material with the most desirable method of disposal is pointed out.

The disposal of the daily accumulation of refuse is a problem of increasing concern, and is a subject of discussion in almost every issue of the leading engineering papers. The articles that appear, however, generally refer to a special method dealing with one or more composite parts of municipal waste. They do not and are not intended to cover the entire disposal problem. The disposal of garbage and the treatment and disposal of sewage are predominantly considered. The published papers illustrate clearly the path followed by the authorities to solve the refuse disposal problem: a certain part of the total communal refuse is dealt with, without due consideration to the other waste material, which is left for later consideration.

This procedure is utterly wrong and is one of the cardinal reasons for many failures and the present deplorable status of the disposal problem.

Municipal waste comprises everything discarded by the individual or community. Sewage is as much a part of municipal waste as street sweepings and discarded bottles. The disposition of the various classes of municipal waste is *one problem* and should be considered as such. This does not mean that only one method of disposal should be employed to consume or utilize the various component parts of the communal refuse—which would be most ideal—but that methods or means shall be chosen to co-operate with each other, forming a unit disposal system. Nor is it necessary to install the entire system at one time. However, it should be so planned and designed that future disposal plants will form integral members of the system and will co-operate with the already installed units.

Such a co-operative system of disposal plants for the total municipal refuse can readily be established and will not only reduce the necessary investment, but will also lower the cost of operation and will increase possible revenues. In fact, a well worked-out disposal system for medium and large cities will prove at least self-supporting and will, in many instances, bring actual revenues.

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*Consulting engineer to the Chicago Incinerator Company.

It is a foregone conclusion that recuperation of the valuable constituents of refuse matters deserves the most careful attention—next to sanitation of the disposal process. All efforts must be bent to assure a financial success. It is with this object in view that the disposal problem should be judged at large, so as not to offset a financial gain in one branch of the disposal system by economic failure of the other members of the system. Full consideration of the interdependence of the different disposal means or units is necessary to achieve an economic success. This point is too often overlooked in the selection of the means of disposal.

In the selection of disposal methods for certain classes of waste, the question of how to dispose of other refuse matter and what the cost of such disposal will be must be clearly defined; and not only the cost of disposal, but also the cost of separate collection will often govern the proper selection of the methods.

Unfortunately, the experience of most cities cannot but convince one of the haphazard nature of the efforts put forth in the solution of the waste disposal problem. Bids are asked for a disposal plant without a proper investigation having been made regarding the amount or the nature of the refuse to be disposed of. That such a negligent proceedure spells failure is evident. Uncertainty in the specifications for bids greatly furthers the malpractice of unscrupulous builders of refuse disposal plants and leads to such conditions as we find, for instance, in the incinerator field, where more than fifty per cent. of the plants built have been abandoned or discontinued. As a protection for the reliable bidder as well as for the city, the greatest care in preliminary investigation is necessary.

To remove the uncertainties and thus minimize failures in the refuse disposal plant, it is necessary to base the solution of this problem upon a scientific basis and discard the prevailing rule-of-thumb methods.

Local conditions, such as topographical, climatic and sociological figure predominantly in the determination of the refuse disposal system. It would be impossible to recommend or advise a standard or perfect system. Each disposal problem presents itself as an individual engineering problem, demanding professional knowledge and practical experience. The municipal official entrusted with the task of laying out a successful disposal system finds himself confronted with a dire lack of standards for reference and comparison. His endeavor to familiarize himself with the requisite professional knowledge is handicapped by a mass of conflicting statements and a lack of concise reference literature for his guidance.

It is beyond the scope of this article to treat the subject exhaustively. We merely endeavor to give a short synopsis of the cardinal points to be considered in developing a successful disposal system.

IMPORTANCE OF STUDY OF QUANTITIES, COMPOSITION AND PROPORTION OF WASTE.

Most important is the correct determination of the quantity and nature of the material to be treated. Each class of waste must be studied separately regarding quantity, composition and relative production in the various sections of the community. The writer holds the view that it leads to serious discrepancies to base the average quantities and composition of the refuse on records per capita of population. We suggest the following classification of waste and the determination of the factors mentioned.

Primarily there are few reliable records permitting us to draw an approximately correct conclusion. Not fifteen per cent of the towns of the United States having 5,000 and more inhabitants have even fairly accurate data regarding quantities of refuse collected. Various attempts made to collect statistics on quantity, nature and method of collection or disposal have foundered on the indifference of municipalities in keeping accurate and complete records. Secondly, too many causative factors depending on geographical, climatic and sociological conditions impede the establishment of probable averages.

A. Liquid and semi-liquid refuse:
  1. Sewage:
    Total amount of sewage;
    Total amount of solids in suspension;
    Average and maximum daily quantities;
    Analysis of sludges to determine
      a. Saponifiable greases and oils,
      b. Fertilizing value of raw sludge,
      c. Calorific value of sludge.
  2. Night Soil:
    Where this matter is separately collected, the total, daily average and daily maximum amount should be known. The value of this material as fertilizer is undisputed.
B. Solid Refuse:
  1. Garbage:
    All refuse of an organic nature, rejected in handling or preparing food;
    Total, daily average and daily maximum amount;
    Analysis to determine
      a. Valuable greases;
      b. Value of raw garbage as fertilizer;
      c. Calorific value;
      d. Food value for hog or cattle feeding.
  2. Rubbish:
    Everything dischar̄ded, not otherwise classified;
    Total, daily average and daily maximum amount;
    Mechanical analysis to determine the amount of salable material, such as metal, paper, glass rags, etc.;
    Determination of the calorific value.
  3. Ashes:
    Total, daily average and daily maximum amount;
    Determination of the calorific value.
  4. Street sweepings:
    Total, daily average and daily maximum amounts;
    Determination of the calorific value.
  5. Stable Manure:
    Total, daily average and daily maximum amount;
    Determination of the calorific value.

The obtaining of a reliable record of quantities and origin of production of the various refuse matters is the most important item. Such records should be kept, even if no improvements in the disposal system are contemplated. It requires at least a one-year record to obtain a conclusive estimate of the quantity, nature, seasonal changes and other necessary characteristics of the refuse production.

An analysis of accurate official records from year to year often enables a great improvement of the existing collection and disposal system and will well repay the amount of labor involved in gathering the data.

In communities where the quantity of each class of material is small, the investigation may be abridged accordingly, but as the time and monetary outlay involved in making a complete research is comparatively small, I recommend a thorough study in most cases. Without complete information, any system installed must be more or less at random, and results are bound to be problematic. As stated before, the failures of many, if not most, disposal systems are chiefly due to lack of a thorough scientific study of the local conditions.

ELEMENTS OF THE PROBLEM.

The problems of collecting, transporting, and finally disposing of communal refuse are closely interwoven. In many instances a comparison of the relative cost of collection and sanitary handling of the refuse will be the deciding factor for one or the other disposal method. This feature is often overlooked and many statements showing on their surface a financial success of a certain disposal means, reveal a failure when properly investigated, on account of the higher cost of collection involved by the disposal methods employed. The collection and transportation of waste to the plants involves the highest cost of operation of a disposal system and should therefore be most prominently considered. We will refer to this feature in our discussion of the various disposal methods.

Economy of operation, reclamation of valuable constituents and, above all, sanitation of the entire system, decide the choice of the final disposal methods. The prospect of a possible financial gain derived from a certain disposal process must be carefully weighed against a possible increase of cost or inconvenience of the entire system. We often find in statements of special disposal process only the cost of operation of the plant itself compared with the financial returns; the higher cost of collection, amortization, depreciation, etc., is wisely omitted. A closer study of all factors pertaining to the disposal system as a whole will often favor a process apparently not so lucrative. The old saying "All is not gold that glitters" is especially true in the field of refuse disposal.

As repeatedly stated, the disposal problem must be approached in a broad way, giving full consideration to all phases and factors essential in the entire system. This demands not only an earnest study and knowledge of the fundamental principles of disposal methods, but also needs a clear conception of the principles underlying the operation of the apparatus used in producing the desired results of the various methods. Numerous failures of reduction plants as well as incinerator plants are due not to the wrong selection of the disposal means, but to the incompetency and utter inadequacy of the apparatus and furnaces.

The most essential factor in handling and disposing of municipal waste in *sanitation*. It does not suffice to make the collection and disposal system inoffensive to the public. Every precaution must be taken to safeguard the health of the operating force. This latter factor is too often neglected and abominable conditions are encountered in some disposal plants. Another important point often overlooked is the dangerous character of the residue from disposal plants. We have seen so-called ash dumps from crematories containing large percentage of putrescible organic matter, hardly less offensive and dangerous than the obsolete garbage dump.

Next to sanitation, the recovery of the valuable constituents demands careful attention. This subject must be approached in the broadest manner, fully considering all phases of the collection and disposal system, with due regard to the cost of operation and installation of all means necessary to treat the entire waste matter. The opportunities of a community must to a great extent control the disposal methods.

The nature and diversity of the material to be handled lends itself readily to many suggestions and experiments. Most of them are visions by men not conversant with the subject and without the requisite technical knowledge. Many such attempts have proven dismal failures. We recommend careful proceedure in trying new methods; however, there is such a thing as being too conservative, which often tends to retard progress.

(To be continued)

"Forced Aeration" Sewage Treatment

Our English contemporary, "Municipal Engineering and the Sanitary Record," believing that the name "Activated Sludge" was not sufficiently expressive of the process of sewage treatment that has been given that name, offered a premium of one guinea for the best suggestion for a substitute. The competition closed April 15th, and in the issue of the 29th that periodical made the following announcement:

> We have pleasure in now announcing that the alternative title suggested by Mr. J. B. Croll, viz., *"Forced Aeration Process,"* is the one which, in the opinion of the judges, is the most successful. A cheque of One Guinea has consequently been forwarded to Mr. Croll, Richmond Main Drainage Works, Kew Gardens. Amongst other titles which were suggested were the following, viz.:
>
> "Aerological-Protoxide of Sewage Purification." Alternative—"Aerological Protoxide Process."
>
> "Alternating Aerobic-Sedimentation."
>
> "Aerated Bio-sludge Mixture." Alternative—"Aerated Bacterio-sludge Mixture."
>
> "The Agitoxy Process."
>
> "Mechanical Aeration Process."
>
> "Biological Sewage Decantation." Alternative—"Intensive Biological Decantation."
>
> "Odorless Aeration System."
>
> "Aerated Bio-inoculation."
>
> "Agitated Biological Activation."
>
> "Oxidized Manurial Sludge." Alternative—"Oxygenous Sludge."
>
> "Dilutærated (or Diluterated) Sludge Amelioration (or Fertivation)." Alternative—"Accelærated (or Accelerated) Sludge Amelioration (or Fertivation)."
>
> "Blow Aeration System."
>
> "The A. S. A. (Agitation, Sedimentation, Aeration) Process."
>
> Aero Biological Process."
>
> "Aerobic Flocculation Process."

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New Name for Activated Sludge

The name "activated" sludge was, we believe, applied to the process so designated by the English investigator who gave the stimulus which has resulted in its recent popularity, and we have sometimes wondered why the American engineers and sanitarians accepted this name, without any suggestion, so far as we are aware, of changing it to one that would be more easily spoken and more suggestive to the uninitiated. The names "contact filters," "sprinkling filters," "septic tanks," "intermittent sand filters," "two-story tanks," all are much more expressive of the distinguishing characteristics of the several processes and are less awkward to pronounce than the term "activated sludge."

We were therefore interested to learn, a few weeks ago, that our English contemporary, Municipal Engineering and the Sanitary Record, was impressed with the same idea and was offering a premium for the best suggestion of a substitute name. The result of this contest is given in another column of this issue, and we must confess to disappointment. Most of the suggestions are, to our mind, even less acceptable than the name now borne by this process. The premium was granted to the name "forced aeration." This term is a little less awkward to speak and write, but is not quite so descriptive of the process as the name which it would replace. Several methods of forced aeration have been experimented with in the past for treating sewage, but the distinctive feature of this process is the mixing with the incoming sewage of sludge which has been treated to an aerating process; consequently the omission of reference to the sludge feature—the vital part—fails to distinguish it from former and unsuccessful uses of forced aeration.

The name activated sludge has now so rooted itself in the language of sewerage engineers and writers on the subject of sewage treatment that it is not probable that a change in the name would be made unless the substitute offered was unquestionably appropriate. As the proposed name does not possess this advantage, in our opinion, we question whether it will be adopted. Possibly we may be mistaken in this, or it may be that some other term may be suggested which will receive the indorsement of sewerage engineers; but with every year that the present name remains in undisputed use, it becomes more firmly fixed in the language and its displacement becomes not only more difficult, but more objectionable because of the increasing amount of literature in which the old term has been used.

Building Zones and Street Classification

A few years ago it was confidently predicted by many that neither public sentiment nor the courts in America would uphold the restricting of private rights to the extent of adopting and putting into force the idea of building zones. The last few years however, have seen the adoption of ordinances establishing such zones in a number of cities and the upholding of such ordinances by the courts. A decision of this kind in East Cleveland is recorded in this issue.

This suggests the idea, which we have referred to before, of the restricting of certain streets to special kinds of traffic, the advantages of which are appreciated by all engineers who are interested in constructing, and especially by those interested in maintaining, the pavements of city roadways. If it is possible to put into effect ordinances limiting the use that can be made of private property by its owners, there would seem to be no question that cities can set aside given streets for specified kinds of traffic, nor any question that the people will submit to and approve of such restriction if they are convinced of its desirability.

With no restrictions on the use of any street which does not apply to all streets, it becomes necessary to make all of the roadway pavements throughout the city adequate for carrying the heaviest and speediest traffic, on either steel or rubber tires, that is not altogether prohibited by city or state law. It should not be difficult to convince any intelligent taxpayer that it costs more to build and maintain a pavement which will carry the heaviest loads without injury than it does to provide a pavement adapted only to delivery wagons and passenger automobiles, with coal wagons as possibly the heaviest vehicles which need use these residential streets.

In addition to this matter of cost of pavement and destruction by heavy vehicles, we have that of convenience to the vehicle owners themselves. The extensive use of a street by slow moving trucks, both horse-drawn and automobile, interferes most aggravatingly with the desire for speed of those riding in passenger automobiles.

Other classifications of traffic will naturally suggest themselves when the subject is considered. The general idea which we wish to suggest, however, is that different classes of traffic be confined to certain specified streets, just as certain classes of buildings on the basis of use, height, etc., are restricted to certain areas of the city. For example, any vehicles weighing more than two tons or carrying more than 1,500 pounds on one wheel might be confined to certain routes through the city. Also, vehicles ordinarily traveling at a speed of less than six miles an hour (or some other limit) might be prevented from using streets which would thereby become favorite routes for speedier vehicles.

Of course, it would be necessary to use great judgment in selecting the routes for the several classes of traffic, but the problem would be by no means an impossible one. It will be rendered all the easier by the adoption of building zones, the latter segregating in certain sections of the city those businesses or industries that require the use of heavy trucks.

It is conservative to estimate that a pavement adequate for light traffic can be built for 50% less than one required by heavy motor trucks. It also seems probable that at least 75% of the mileage of streets in the city could be restricted to the lighter traffic. This would mean that a saving might be made of 37½% of the cost of pavement construction in a city by the restricting of motor trucks to certain routes. As a matter of fact, we believe that 10% of the street mileage would furnish adequate routes for heavy trucking, thus giving a saving of 45% of the construction cost. In addition to this, with the heavy trucking limited to a few streets, the authorities would naturally feel that they could afford to spend more money on this limited mileage in order to secure heavier pavements than they would feel warranted in providing for all of the streets in the city on the chance that they might be used by heavy trucks.

Other considerations naturally suggest themselves, whereby the requirements of each class of vehicles could be studied, and pavements be classified so as to meet more fully the requirements and wear of each class of traffic than would be possible where provision had to be made for use of the same pavement by all kinds of traffic.

It is no argument against this idea that it has not been put into practice before this, one explanation undoubtedly being that paving is only now developing into a science, with much to be accomplished before even the fundamentals of that science are well understood; while on the other hand, it is only within a few years that vehicles have become so diversified as to weight, speed, nature of tire and other conditions which are largely responsible for the need for this classification of traffic and of the highways allotted to carrying it.

Replacing Pavement Surfaces

As the nature of traffic on a street changes, or as the science of paving develops, or the officials of a given city change their ideas as to pavements, it often becomes desirable to replace an old wearing surface with another of a different kind. And the old base will of course be used if possible. But trouble arises from the divers thickness of wearing surfaces, which may vary from an ⅛-inch bituminous carpet on a concrete pavement to an old-style 8-inch stone block on a 2-inch sand cushion. Modern specifcations call for stone blocks 5 inches deep, and wood blocks or bricks 4 inches deep, with or without a 1-inch cushion; while a 3-inch depth of combined sheet asphalt and binder is common. A carpet is seldom used in city paving on a concrete base.

We have, therefore, the depths 3, 4, 5 and 6 inches from pavement surface to top of base as common city practice. If we try to substitute a new 3-inch surface for an old 6-inch one, we must either tolerate a high curb face and lower the manhole heads and similar objects set in the pavement, or else add three inches to the concrete base; neither of which is seriously objectionable except for the cost of the latter.

But, if we try to substitute a 6-inch stone block surface for a 3-inch asphalt one, we find that either the pavement grade must be raised 3 inches, thus reducing the curb height by that amount and necessitating raising manholes, railway tracks, etc., or else the old base must be abandoned, involving the cost not only of building a new one but also of removing the old. Either alternative possesses serious disadvantages.

Either brick or wood block can be set on a concrete base in a thin mortar cushion, thus raising the pavement only one inch higher than the former sheet asphalt, which is not often seriously objectionable; or blocks or brick only 3 inches thick can be used, the latter the so-called vertical fiber brick. And some cities have replaced these thin surfaces with stone blocks, using those of small dimensions known as durax. Such use of stone blocks in New York City is described in this issue.

With 4-inch blocks of wood, stone and brick used for paving, it suggests itself whether this could not be made a standard thickness for sheet asphalt as well, as by increasing the thickness of the binder. We would thus have all standard kinds of pavement (including bituminous concrete) with wearing surfaces of practically the same thickness and therefore any one could be replaced with any of the others without any additional expense being involved or the street grade changed.

Hetch-Hetchy Aqueduct Tunnel Contract Let

The contract for the construction of 18 miles of aqueduct tunnel for the Hetch-Hetchy water supply to the city of San Francisco was awarded on May 3 to the Northern Construction Company of North America, for an estimated sum of $7,802,952 on the basis of cost-plus-a-fixed-fee for the contractor. The contract has already been approved by the Board of Public Works, ratified by the Board of Supervisors and threatened with a taxpayers' injunction suit. In order to finance the work, it is necessary to immediately sell $8,000,000 of water bonds, and the fact, already stated in these columns, that these bonds are at a heavy discount is causing much trouble. They are quoted on the local market at 87½ per cent and as the city charter forbids their sale at less than par, considerable juggling is necessary to accomplish the deal and has finally been provided for by making the contractor's fee large enough to cover the difference between par and market value and include compensation to him for supervision of the work.

This, of course, meets with strong local opposition, especially as one of the competitive bidders on a straight unit-cost bid offered to do the work for nearly $2,000,000 less than the estimated cost under the present contract.

The project includes the development of a large and valuable water power, potential in the supply brought from a source hundreds of feet higher than the elevation of the city, and the opponents of the scheme are denouncing this feature, which does not materially increase the cost of construction and conserves a great deal of energy that it would be inexcusable to waste, while it in no way delays the delivery of water for domestic purposes.

Improvement of Freight and Passenger Transportation

At the Atlantic convention of the United States Chamber of Commerce the committee on resolutions presented a number of resolutions and declarations concerning various important public interests which were passed by the large number of delegates in attendance from all parts of the country.

These delegates represent the most prominent successful and conservative business and professional men in their respective communities and their views may be safely taken to express the most careful and farsighted opinions of the responsible elements of the nation and as such are entitled to great weight. Among these resolutions are two that are especially pertinent to the field of Public Works, that were recorded as follows:

Waterways

Waterways afford opportunities for increasing the facilities of transportation available to our industries and commerce. Immediate needs for movement of fuel, materials, and products require that Congress should at once make appropriations ample for improvement and maintenance of commercially meritorious harbor, river-channel and canal projects which it has approved and which have the interrelation with one another or with other means of transportation that is essential for routes of traffic.

Traction Services

Every phase of the life of a community is affected by the success or failure of its traction lines in providing a service which is indispensable to the public. Careful regulation joined with concern for the business stability and success of traction lines should prevail in each city of the country. Adequacy of service at the lowest rate compatible with continued efficiency is the paramount consideration from the public point of view, and neither factor can be sacrificed to the other without public detriment. Each community is urged to consider the situation of its traction service from these two points of view, in order that it may ascertain if the increased costs common to all business have been unaccompanied by added revenues sufficient to maintain the service requisite for the industrial and commercial efficiency of the community.

Century-Old Bequests for Convenience Stations

Funds accrued from provisions of the wills of Benjamin Franklin and of John Scott, another early Philadelphian, are to be used by the Board of City Trusts of Philadelphia, Pa., for the erection of public convenience stations.

Agreement to that effect was reached last week at a meeting of the board, which acted upon a suggestion by Mayor Moore.

The funds total $80,408. They include and have accrued from a bequest of £1,000 left by Franklin to "make living in the town more convenient to its people, and more agreeable to strangers," to be applied after one hundred years, and a similar bequest of $3,000 left by Scott.

Farmers Favor National Highway System

Farm sentiment is very strongly in favor of the construction and maintenance of a national system of highways, if replies received to a referendum by the American Farm Bureau Federation can be taken as a criterion. The federation is one of the largest farm organizations in the United States. Answers to the highway question are almost unanimously in favor of a broadened national road policy.

County Highway Data

Information from county highway officials supplementing that tabulated in our issue of April 3. Work done during 1919—Practice as to road shoulders—Resurfacing highways.

Information of various kinds concerning county highway work done during 1919, with details of construction and repairing, was given in the April 3 issue of Public Works. The tables in this issue contained information which had been received, in response to our questionnaire, up to about a week prior to publication. Since that time we have received a number of additional responses, and we give in this issue supplementary data on the same points covered by our tables in the April 3 issue.

Many of the cards received contained additional data concerning the cost of maintaining pavements of different kinds, none of which has yet been presented. We expect to give this information in tables to be published next week. These tables will give, for each of a considerable number of cities, the cost per square yard or per mile for maintaining various kinds of pavements, together with the length of pavement maintained, its average width, such information as could be given concerning the amount of travel over the road, the expenditure for maintainence during 1919, and the average cost for a period of years.

Concerning the supplementary data in this issue, there is little to add to the comments given in our April 3 issue. One of the points that has been brought most forcibly to our attention is the fact that a very considerable proportion of the counties have kept no adequate records of work done. A very common reply received by us from county engineers was that they have been in their present position for only a few months, and that the records of their predecessors do not furnish any information from which they could answer questions as to amount of work done, cost, or other essential facts concerning either construction or maintenance of the county's highways. It is encouraging, however, to note that very many of these recognize that there should be records from which our questionnaire could be answered and assure us that, if a similar one reaches them a year from now, they will then be able to answer it from the records which they are now keeping or are preparing to keep during the current year of work.

PRACTICE AS TO ROAD SHOULDERS.

State and County	Type of Road	Width of Shoulder, Feet	Material Used on, or Other Treatment of Shoulder	Protection of Edges of Pavement
Alabama:				
Madison	gravel	4	none	earth banked against gravel
Mobile	gravel	4	none	curb on some
Idaho:				
Benewah	plain macadam	20' roadbed, 18' surfacing	....	....
Bonneville	....	3	gravel	....
Caribou	....	20' on state highway, 18' on county roads	....	....
Seventh Dist...	....	3	....	none
Illinois:				
Stephenson	....	18' hard pavement, 6' earth; 10' hard pavement, 3' stone and 6' earth	....	 none
McHenry	....	6' earth, 10' concrete, 4' gravel and 6' earth	patched with gravel	none
Menard	....	10' concrete with 4' shoulders	water-bound macadam	none
Washington ...	....	....	earth with macadam	....
Indiana:				
Dubois	....	5½	none	none
Iowa:				
Clayton	....	6	gravel surface	street curb bare
Pottawattomie..	....	3', with concrete pavements	crushed limestone	none
Kentucky:				
Graves	....	3' earth	Bermuda grass on fresh fills	....
Russell	....	3' with 14' metal; 5½' with 9' metal	....	....
Louisiana:				
Avayelles	....	5' earth with gravel types	....	....
Maryland:				
Kent	....	5' of dirt	none	none
Michigan:				
St. Clair........	....	4	none	none
Minnesota:				
Anoka	concrete	4' 1919; 6' 1920	no special material	none
Cottonwood ...	....	5	....	....
Isanti	....	6	none	....
Martin	....	24' on dirt road	....	....
Ottertail	....	24 and 30	....	....
Swift	....	4' on 18' concrete	maintenance gravel	none
Wilkin	....	24	....	....
Mississippi:				
Noxubee	gravel	20 and 22	shoulders dragged, slopes sodded	....
Missouri:				
Miller	gravel	2' to 4' on gravel roads	plain earth	....
Montana:				
Flathead	....	3	none	none
Phillips	....	16	....	....
Sheridan	gravel	5	....	....
New Jersey:				
Sussex	....	5' with old roads, 6' on all others	earth; scraped, cleaned and rolled each spring	none
New York:				
Oneida	....	.5	....	none
North Carolina:				
Beaufort	dirt	....	....	....
North Dakota:				
Hettinger	....	34' roadway, 6' berm	....	....
Ohio:				
Mercer	....	5	none	none
Oklahoma:				
Alfalfa	dirt	3' stone, 3' additional earth	oiling	metal inserted shields
Oregon:				
Columbia	....	16	....	....
Multnomah	....	2' macadam, with bit. concrete	macadam	....
Tenessee:				
Campbell	....	4' on each side, earth	none	4' earth shoulders
Vermont:				
Orleans	telford stone road	3'6"	dirt	9
Washington:				
Clarke	....	3	....	none
King	....	2', gradually widened by maintenance crews	gravelly material from sub-grade	Flush curb of concrete for brick, 3"x8" timber header for monolithic brick
Lewis	....	4	earth	....
West Virginia:				
Monongalia	....	3	crushed stone, thoroughly rolled	....
Wisconsin:				
Forest	earth	6	....	....
Waushara	....	20'-24' roadbed	....	....

COUNTY HIGHWAY WORK DONE DURING 1919.

State and County	Amount of county, state and federal money spent	Bitum. concrete, mi. or sq. yds.	Bitum. macad. mi. or sq. yds.	Plain macad. mi. or sq. yds.	Sand-clay, mi. or sq. yds.	Gravel, mi. or sq. yds.	Cement concrete, mi. or sq. yds.	Brick mi. or sq. yds.	Earth, miles or sq. yds.	Other work	Done by county or state forces	Done by contract
Alabama:												
Madison	$100,000	......	......	1	......	?	......	......	......	......	All	None
Mobile	180,300	......	......	......	......	½	......	......	......	Rock asphalt, ½	, Maintenance	1
Pike	65,000	......	......	......	8	......	......	......	......	......	All	None
California:												
Modoc	40,000	......	......	small amount	......	small amount	......	......	......	Maintenance	All	None
Idaho:												
Boise	100,000	......	......	......	......	......	......	......	?	......	None	All
Bonneville	100,000	......	......	......	......	......	......	......	......	Grading, 40	All	None
Caribou	......	......	......	......	......	......	......	......	......	Maintenance	......	All
Idaho	1,082,000	......	......	4	......	......	......	......	66	......	None	All
Lemhi	310,000	......	......	......	......	4	......	......	......	50	None	All
Seventh District	100,000	......	......	......	......	6	......	......	......	......	None	All
Valley	30,000	......	......	......	......	......	......	......	40	......	All	None
Illinois:												
McHenry	143,000	......	......	......	......	2¼	½	......	......	Bridges & maintenance	None	All
Marion	35,000	......	......	......	......	......	1	......	......	Bridges	None	All
Menard	200,000	......	......	......	......	......	?	......	......	......	$55,000	Remainder
Stephenson	100,000	......	......	1	......	......	2	......	......	Oiled earth, 33; Graded earth, 150	Graded earth, 150	Remainder
Washington	40,000	......	......	......	......	......	......	......	All	......	None	All
Indiana:												
Newton	47,000	......	......	......	......	......	......	......	......	Stone repair	All	None
Iowa:												
Appanoose	60,640	......	......	......	......	......	......	......	All	......	$55,140	$5,500
Chickasaw	95,000	......	......	......	......	12½	......	......	......	......	$65,000	$30,000
Clayton	90,000	......	......	......	......	½	......	......	2	......	All	None
Hardin	110,006	......	......	......	......	?	......	......	......	......	$65,555	$44,450
Mahaska	151,000	......	......	......	......	......	......	......	All	......	$89,000	$52,000
Pocohontas	164,826	......	......	......	......	17.2	......	......	......	$139,576	$137,316	$27,510
Pottawattamie	222,213	......	......	......	......	......	......	......	All	......	Half	Half
Kentucky:												
Graves	42,000	......	......	......	......	5	......	......	......	......	All	None
Russell	9,500	......	......	......	......	......	......	......	......	Grading & repairing earth roads	All	None
Louisiana:												
Avoyelles	30,000	......	......	......	......	4	......	......	......	......	None	All
Maryland:												
Kent	147,500	......	......	......	......	3	3	......	......	Resurfacing, 2.65; pit run, 1	3.65	5.65
Michigan:												
St. Clair	800,000	......	......	......	......	60,000	160,000	......	......	......	15,000 sq. yds.	4,050 sq. yds.
Washtenaw	200,000	......	......	......	......	7	......	......	......	Asphaltic concrete, 3; maintenance, 75	66 2-3%	33 1-3%
Minnesota:												
Anoka	217,997	6.6	......	......	......	14	......	......	......	......	None	All
Clay	72,000	......	......	......	......	?	......	......	?	......	All	None
Cottonwood	100,000	......	......	......	......	18	......	......	......	......	1	17
Isanti	27,638	......	......	......	......	7.03	......	......	......	......	1.5	5.53
Mc Leod	50,307	......	......	......	......	All	......	......	......	......	None	All
Martin	140,000	......	......	......	......	5	......	......	10	......	All	None
Ottertail	155,000	......	......	......	......	12	......	......	30	......	$73,000	$82,000
Roseau	38,416	......	......	......	......	......	......	......	14	......	10%	90%
Swift	171,500	1.5	......	......	......	4	......	......	......	......	Gravel & unsurfaced work	concrete
Wilkin	25,000	......	......	......	......	......	......	......	All	Grading, 7	All	None
Mississippi:												
Itawamba	50,000	......	......	......	......	......	......	......	......	Grading & finishing	None	All
Missouri:												
Madison	12,928	......	......	......	......	......	......	......	......	Maintenance, $9,960; culverts, $2,968	All	None
Miller	$10,000	......	......	......	......	5	......	......	25	Maintenance	All	None

COUNTY HIGHWAY WORK DONE DURING 1919 (Continued).

State and County	Amount of county, state and federal money spent	Bitum. concrete, ml. or sq. yds.	Bitum. macad. ml. or sq. yds.	Plain macad. ml. or sq. yds.	Sand-clay, ml. or sq. yds.	Gravel, ml. or sq. yds.	Cement concrete, ml. or sq. yds.	Brick ml. or sq. yds.	Earth, miles or sq. yds.	Other work	Done by county or state forces	Done by contract
Montana:												
Flathead	135,718	......	......	......	......	All	......	......	......	Bridges	All	None
Meagher	197,402	......	......	......	......	5	......	......	75	......	$95,402	$102,000
Phillips	70,000	......	......	......	......	......	......	......	25	Fills and bridges	90%	10%
Sheridan	40,000	......	......	......	......	All	......	......	......	......	70%	30%
New Jersey:												
Sussex	140,000	......	2	......	......	4	......	......	......	Penetration 1, grad'g 2, repair work	$110,000	$30,000
New York:												
Oneida	195,632	0.52	0.32	4.25	......	......	1.42	......	......	Bitulithic 0.73	None	All
North Carolina:												
Beaufort	676,000	......	......	......	......	......	600,000	......	......	Maintenance roads & bridges $76,000	None	All
North Dakota:												
Grant	40,000	......	......	......	......	......	......	......	All	......	25%	75%
Hettinger	125,000	......	......	......	......	......	......	......	All	......	10%	90%
Ohio:												
Mercer	80,000	......	......	5	......	2	1½	......	......	......	Nono	All
Oklahoma:												
Alfalfa	126,000	......	......	......	......	......	......	......	175 ml.	Drain. open'gs & fills	All	None
Kiowa	58,000	......	......	......	......	......	......	......	......	......	7	6
Oregon:												
Columbia	215,592	......	......	......	......	......	2	......	Remainder	......	All but 5	5
Multnomah	493,995	81,018	......	5⅓	......	15	9,875	......	......	......	$266,979	$227,016
Sherman	56,000	......	......	2	......	......	......	......	......	......	All	None
Wheeler	500,000	......	......	all	......	......	......	......	......	......	$200,000	$200,000
South Dakota:												
Corson	51,000	......	......	......	......	......	......	......	All	......		
Edmunds	75,000	......	......	......	......	......	......	......	25	Elevator and fresno work, 36	25	36
Yankton	116,250	......	......	......	......	10	......	......	......	......	All	Nono
Tennessee:												
Campbell	100,000	......	......	6	......	......	......	......	8	......	None	All
Vermont:												
Orelans	30,000	......	......	......	......	All	......	......	......	......		
Washington:												
Clarke	591,800	......	......	......	......	10	1½	......	......	Bitulithic 13	$25,000 Gravel 10	$5,000 14½
Douglas	495,000	......	......	Some	......	Some	......	......	......	......	None	All
King	1,101,857	......	......	......	......	23.3	13.52	......	......	......	20	Remainder
Lewis	507,651	......	......	......	......	......	6.7	......	......	......	$278,070	$246,000
West Virginia:												
Boone	30,000	......	......	......	......	......	......	......	......	Surface & drainage 5	None	All
Monongalia	140,000	......	......	......	......	......	4	......	......	......	All	None
Wisconsin:												
Forest	186,000	......	......	......	......	......	......	......	All	......	$160,000	$26,000
Waushara	61,000	......	......	......	......	......	½	......	......	Macadam & gravel 12	9	3
Washburn	54,000	......	......	......	......	......	......	......	......	Grading	$28,000	$26,000
Johnson	36,000	......	......	......	......	......	......	......	......	......	$5,000	$31,000

RESURFACING COUNTY HIGHWAYS.

State and County.	Kind of pavement resurfaced.	Material used for resurfacing.	Age of old pavement.	Treatment of Old Surface Before Adding New Material.	Cost of resurfacing per mile or sq. yd.	Use made of old materials.
Alabama:						
Madison	Gravel	Gravel	5 to 10 years	Scarifying, leveling with grader and rolling	$0.50	......
Illinois:						
McHenry	Gravel	Gravel screened thro 1-in. sc.	3 years	....	15.04	......
Stephenson	Macadam	Crushed stone	15 years	Scarified, crowned, and new material added	1.00	.....

Indiana:						
Dubois	Macadam	Macadam	10 to 2 years	Nothing	....	......
Newton	Macadam	¾-in. stone and dust	12 to 20 yrs.	Nothing	....	......
Iowa:						
Clayton	I mi. macadam	Gravel	5 years	Loose material scraped off	....	......
Pocahontas	Gravel	....	......	....	....	......
Kentucky:						
Graves	Gravel	Gravel	6 years	Scarifier, harrowed longitudinally and reshaped with grader	3,500.00	......
Louisiana:						
Avoyelles	Gravel and dirt	Gravel on grav. & dirt on dirt	......	....	....	......
Maryland:						
Kent	Shell road	Water-bound macadam	2 years	Stone placed 3 ins. deep and 9 ft. wide and rolled to 2 ins. tight and covered with tar and chips	6,000.00	......
Mississippi:						
Noxubee	Gravel	Gravel	5-6 years	Repaired ruts and holes	75.00	......
Montana:						
Flathead	Gravel	Crushed rock and gravel	3-5 years	Scarified and reshaped	....	......
New Jersey:						
Sussex	Macadam	Mac. top-dressed with asph.	6-9 years	Spiked up with roller, new material added and rolled into place	....	......
New York:						
Oneida	Bit. macadam Water-bound mac. Gravel	Bituminous mat. Bituminous macadam Bit. con. (2-in-top ¾-in. stn. & asph. emul. mixed con. mix'r)	7 years 12 years 8 years	....	13,700.00 13,700.00 8,153.00	On shoulders
North Carolina:						
Grant	Earth	....	......	....	....	......
Ohio:						
Mercer	Bit. macadam	Tar and stone chip	3 years	....	....	......
Oregon:						
Multnomah	Macadam	Crushed rock	2-5 years	Scarified, new rock added and rolled	6,000.00	......
Tennessee:						
Campbell	....	....	1-15 years	Scarified, new rock added and rolled	3,500	......
Vermont:						
Orleans	Gravel	Gravel	1-6 years	Added gravel.	75c-$4 rod	......
Washington:						
King	Bituminous concr. Brick Cement concrete	Repairs, same as original Repairs, same as original Repairs, same as original	7-9 years 2-7 years 0-4 years	....	....	....

Board for Jurisdictional Awards in the Building Industry

Rudolph P. Miller, representing Engineering Council on the Board for Jurisdictional Awards in the Building Industry, reports that the work of this Board is proceeding most satisfactorily, and that there is a feeling, particularly among the labor unions, that its work will be very helpful in adjusting difficulties which lead to strikes. One labor representative stated at the meeting held in Washington, D. C., March 8 to 11, 1920, that the Board had accomplished in a few days what the contending organizations had failed to do in some years. At this meeting the following controversies between international unions were considered and disposed of:

1—Controversy between the Amalgamated Sheet Metal Workers' International Alliance and the United Association of Plumbers, Steam Fitters and Steam Fitters' Helpers.

2—Controversy between the United Association of Plumbers, Steam Fitters and Steam Fitters' Helpers, and the International Union of Steam Engineers.

3—Controversy between the Bridge and Structural Iron Workers' International Association and the United Association of Plumbers and Steam Fitters.

4—Controversy between Operative Plasterers and Cement Finishers' International Association and the Wood, Wire and Metal Lathers' International Union.

5—Controversy between the Amalgamated Sheet Metal Workers' International Association and the Brotherhood of Painters and Decorators.

6—Controversy between the Bridge and Structural Iron Workers' International Association and the Wood, Wire and Metal Lathers' International Union, on the placing of reinforcement for reinforced concrete, cement and floor construction. After hearing argument, it was decided "that all iron and steel used for reinforcement in reinforced concrete, cement and floor construction should be awarded to the iron workers."

Philadelphia Carpenters' Strike Settled

The strike of the carpenters and joiners in Philadelphia has been officially ended. The original compromise offer of $1.12½ an hour having been accepted by members of the union committee. The men will receive double time for all overtime. They will not work any Saturday during July and August and they are to be off all legal holidays. A full week consists of forty-four hours.

Aside from these changes, the new agreement, which expires April 30, 1921, is the same as the 1919 agreement.

Of 1,183,000 wage-earners in Massachusetts 173,000 have an annual income of $2,000 or more.

Decreasing Man Power

Washington statistics show that for the five months commencing last July, immigration to this country totaled 125,000 and emigration from it 144,000 showing a loss of 19,000 people. During this period, only 1,000 Greeks landed in America and 11,500 of that nationality left America. During this period, however, 19,000 immigrants crossed the Rio Grande and only 3,000 returned over it to Mexico. The balance with England was about 17,000 in our favor.

According to an announcement by the Interracial Council, of New York City, 275,000 emigrants have left this country since the armistice, taking $550,000,000 with them, while during the some period immigration has consisted largely of war widows and other women or industrial nonproducers.

British Emigration Restricted

Reports from London state that the British Government is making every effort to circumscribe and direct the current of emigration so that men and women leaving Great Britain will go to the British colonies rather than to the United States.

For months past all of the American consulates in the United Kingdom have been besieged with numerous inquiries for information about the prospects in America, and there are many thousands of the British subjects that would come to the United States immediately if they were permitted to do so and could secure transportation.

Italian Immigration in 1919 and 1913

The New York office of the Navigazione Generale Italiana and La Veloce reports on the passenger movement from Italian to United States ports that "3,374 steerage passengers have arrived by our steamers in New York since April 1; the last ship to arrive, April 16, 1920, landed 1,322 steerage passengers; 16,951 passengers landed since January 1 on the steamers under our control. The number of passengers landed in 1919 by the steamers of the Navigazione Generale Italiana and La Veloce was 12,596, while the number of passengers landed in 1913 by the steamers of the Navigazione Generale Italiana and La Veloce and Italia Line was 63,651."

Labor Shortage in New England

Reports from Boston state that the demand for help from employers during April at the public employment office on Kneeland Street shows an increase of 35 per cent over last year, also an increase of 9 per cent over March this year. The number of positions reported filed shows an increase of 45 per cent over last year and 20 per cent over March this year.

In the male skilled department machinists and helpers were most in demand, principally for arsenal work. There has been little or no call from the building trades, with the exception of painters. A number of young men are wanted for factory work, but applicants are holding off on account of the wages offered being too small.

Engineers and firemen have been in little demand, with quite a number on hand looking for work. It is usual at this time of the year to receive frequent calls for hoisting engineers on construction work, but so far this season there has been no demand. The call for clerical and mercantile help continues to be negligible, with large numbers of applicants looking for such work.

There has been a heavy demand for able-bodied laborers both for inside and outside work, with only a fair supply of applicants. Although there has been a good demand for farmhands at wages much higher than pre-war rates, there are very few applicants for this kind of work in sight and many orders remain unfilled. The demand for boys for errands, office and factory work continues to be heavy, with a very indifferent class of applicants.

It is reported that three days after 7,000 carpenters went out on strike in Philadelphia, May 1, 3,000 returned to work on a $60 per week wage scale granted by 119 contractors. This scale of $1.25 per hour will yield as high as $80 a week with overtime.

Chicago employers promised mill carpenters an increase from 85 cents to $1.10 per hour on June 1, the workmen nevertheless went out on strike and if they remain out, will seriously cripple spring building operations by interrupting the supply of sashes, doors, blinds, window frames and trim for outside carpenters.

Trolley Strike Settled

The strike of the trolleymen employed by the Richmond Light & Railroad Company, Staten Island, was settled by raising the minimum wage from 40 cents to 50 cents per hour, increasing to 60 cents per hour at the end of the first year. The company has claimed that it was losing money at the old scale, and has been permitted to raise fares of adults from 5 cents to 7½ cents, an amount which it is doubtful will make up the increased $150,000 expense involved by raising the wages, especially as the fare for school children has been reduced from 4 cents to 3 cents.

Serious labor troubles in St. Paul have developed, at the last accounts, a threat of a strike of about 7,000 workers with a threat of tying up of all building operations. It is claimed that the labor unions are so fully organized that they are nearly 100 per cent efficient in that city and that 12 contractors, none of whom, however, are members of the Builders' Exchange, have acceded to the demands which include a rate of 60 cents per hour to be effected May 1 for common labor. This represents an increase of 166 2/3 per cent in five years and still falls short of the union demand, which is for an increase of 233 per cent in the same period.

A Novel Idea in Reinforcement

An original method of constructing a large reinforced concrete girder during cold weather was adopted at Toronto. The girder, which has a clear span of 51 feet and is 13 feet deep and 2 feet 2 inches wide, had two 7-inch steam pipes run through it from end to end, one 3 feet and the other 8 feet from the bottom of the girder. After the girder had set and the pipes had fulfilled their function, they were cut at the ends and left in the girder, thus forming an additional reinforcement.

Recent Legal Decisions

CONTRACT FOR PUBLIC WORKS NOT INVALID BECAUSE COST EXCEEDS ESTIMATE.

In consolidated actions by property owners to enjoin a city from proceeding under a contract for street paving, it was contended by the plaintiffs that the cost of the improvement exceeded the estimated cost, and that this was not allowable under the law. The Iowa Supreme Court, Miller v. City of Glenwood, 176 N. W. 373, refused to sustain this contention for the following reasons: It is quite impossible, in estimating the cost of a public work of this kind, to determine in advance the actual cost the city will incur in its completion. The estimate often proves inadequate. It is only for the purpose of advising those who may be called upon to meet the expense, when incurred, of the probable cost, as a basis for concluding whether the probable cost will exceed the probable benefits to be conferred by the improvement. If cities were to be held to a strict rule in estimating costs, it would never be safe to enter upon any scheme of public improvement. After the estimate, and before the contract is let, there may be such an increase in wages and cost of material that it would be utterly impossible to perform the work within the limits of the estimate. In the absence of fraud or collusion or something of that sort, the fact that the completed work exceeds the amount of the estimate does not leave the city without jurisdiction to assess abutting property its proportionate share, measured by the rules governing the special assessment.

CONTRACTOR'S BOND—PROTECTION OF LABORERS AND MATERIALMEN.

The Nebraska Supreme Court holds, Nye-Schneider-Fowler Co. v. Roeser, 173 N. W. 605, that the state statute which requires public officials to take a bond from a contractor to pay for labor and materials used in constructing a public building is absolute, and the contract and bond will be construed to protect such laborers and materialmen if the terms of the contract and bond are ambiguous, or if they will admit of such construction.

A contract and bond "for the erection and completion of a school building" contemplates that the contractor will furnish the labor and materials, and the bond undertakes that he will do so, and, liberally construed as an attempted compliance with the statute, it includes payment by the contractor for the labor and materials.

BIDS FOR PUBLIC WORK—WITHDRAWAL.

A mistake on the part of one bidding upon public work may justify the relief in equity of the bidder from his bid, on the theory that there was no contract, and in the eye of the law no meeting of the minds. But an examination of the cases seems to indicate that relief has been granted only where there was an actual mistake in the bid itself, such that it failed to express the intention of the bidder at the time he offered it. So it is held, Foley Contracting Corp. v. Green, 108 Misc. (N. Y.), 520, 177 N. Y. Supp. 779, that a contractor cannot put in a first bid merely to preserve his rights and afterwards attempt to supersede it with a higher bid on the theory of mistake.

NOTICE FOR INJURY UNDER CONTRACTORS' INDEMNITY POLICY.

Paving contractors secured from an insurance company an indemnity policy against liability for bodily injuries accidentally sustained by members of the general public in the performance of a paving contract. Two persons injured by collision with a vehicle of the contractors used on the job sued and recovered damages from the city, which obtained a judgment against the contractors, who sued the insurance company on the policy. The Michigan Supreme Court held, Vandervliet v. Standard Acc. Ins. Co., 176 N. W. 574, that evidence that the insurance company had actual notice of the happening of the accident, and that it did not deny liability on the failure to give notice as required by the policy, but sent a representative to confer with the insured contractors, justified the submission to the jury of the question of estoppel of the insurer to deny notice. Assuming it intended to rely on failure to give notice, the insurance company was not justified in taking up the contractors' time to interview witnesses and obtain statements from them. An instruction to the jury that the burden was on the plaintiff to show that written notice was waived, that verbal notice had been timely given, and that the insurer waived its right to insist upon earlier notice was held warranted under these facts.

TIME FOR FILING CLAIM FOR LABOR OR MATERIAL AGAINST SURETY FOR PUBLIC WORK CONTRACTOR.

Section 77 of Massachusetts Rev. Laws, c. 6, provides that officers or agents who contract for the commonwealth for the construction or repair of a public building or other public work shall obtain security for payment by the contractor and subcontractors for labor performed and furnished and for materials used. The section also provides that a claimant for labor or material against the surety of a contractor for a public work shall file a sworn statement of his claim with the officers or agents of the commonwealth within 60 days after completion of the work. The Massachusetts Supreme Court holds, Bay State Dredging & Contracting Co. v. W. H. Ellis & Son Co., 126 N. E. 468, that the "work" here refers to the public work embraced within the terms of the contract as it existed when the contractor or subcontractor was required to furnish sufficient security for the labor and material to be performed or furnished; and the right to have the benefit of the section enures to any laborer or materialman who has furnished labor or material which was used or employed in the construction or repair of the public work if he shall file a sworn statement of his claim within 60 days after the completion of the work contemplated by the original contract, even if it be not completed by the original contractor.

NEWS OF THE SOCIETIES

May 21-26.—NEW JERSEY STATE BUILDING TRADES COUNCIL. Atlantic City, N. J

June 3-4.—NATIONAL STATE AND LOCAL ENGINEERING SOCIETIES. Organizing conference will be held at Washington, D. C.

June 16-18. NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual Convention, Asheville, N. C.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting. Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS. Asbury Park, N. J. Office of secretary, Philadelphia.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION. San Francisco. Office of secretary, Boston.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Boston, Massachusetts.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 401 Lincoln avenue, Valparaiso, Ind.

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League of Texas Municipalities.

The eighth annual convention of the League of Texas Municipalities was held in the City Hall Auditorium, Dallas, Texas, on May 13, 14 and 15. The officers of the league are: President, Mayor Frank W. Wozencraft, Dallas; Vice-presidents, Mayor W. J. Nichols, Texarkana; City Manager E. L. Wells, Jr., San Angelo; City Attorney J. B. Rector, Austin; Secretary-treasurer, Frank M. Stewart, Austin. Secretariat, Bureau of Government Research, University of Texas, Frank M. Stewart, secretary; Mrs. Sarah S. Edwards, reference assistant; John R. Anthony, research assistant; Wm. B. Ball, research assistant; Robert D. Jackson, assistant.

The annual membership dues for active members are: Cities less than 5,000 population, $5; 5,000 to 15,000 population, $10; 15,000 to 25,000 population, $15; 25,000 to 50,000 population, $20; 50,000 to 100,000, $25; over 100,000 population, $30. Associate members, $1.

The convention held six public sessions and one executive session, were the mayor's guests at dinner, and made an automobile excursion through the city and to points of interest. The principal papers presented included: City Purchasing; The City Manager Plan; Municipal Bonds and Bond Issues; Municipal Taxation and Revenues; Municipal Taxation; Paving Street Maintenance; Municipal Forestry; City Planning—addresses by George E. Kessler and Robert H. Whitten, city planning experts, St. Louis, Mo.; Public Utility Regulation; Report of Public Utilities Committee of Seven (discussion of report); Sewerage Systems and Disposal Plants; Water Plant Construction and Operation; Malaria and Mosquito Control; Organization of City Health Department; Pure Food Regulations; Pure Water Supply for a City; Municipal Markets and Reduction of Living Cost; Municipal Welfare Department.

Chamber of Commerce of the United States.

At the eighth annual meeting of the Chamber of Commerce of the Unitde States, held in Atlantic City, April 26-29, in connection with a meeting of the National Counsellors of the Chamber and a meeting of the National Association of Organization of Secretaries, there was a very large attendance of distinguished representatives from all parts of the United States, and the important list of vital subjects considered included Increased Production, International Finance, Transportation, Foreign Commerce, Cost Accounting, Domestic Distribution, Insurance, Civic Development, International Chamber of Commerce, The Business Press, The Government and Production, Labor, Agriculture, and Industrial Production.

The subject of transportation and its relation to increased production was taken up in all its phases. One group gave its attention to railroads, another to shipping and a third to highways and motor transportation. The railroad group heard the report of the Railroad Committee of the National Chamber, which set forth facts with reference to recent railroad legislation and the present situation of the rail lines. It heard George A. Post, president of the Standard Coupler Company, of New York; John E. Oldham, of Boston, and Charles E. Lee, transportation engineer, of New York.

Civic Development occupied a group under chairman R. G. Rhett, president of the Peoples National Bank, Charleston, S. C. Leaders in the discussion were George M. Verity, president of the Middletown, Ohio, Chamber of Commerce; James T. Lloyd, of the Washington, D. C., Chamber of Commerce, and Mrs Sophie E. Delavan, president of the Woman's Association of Commerce, of Chicago.

Labor in Relation to Production was a subject treated from the standpoint of the employer and the employe. Labor's view was presented by Matthew Woll, vice-president and member of the executive council of the American Federation of Labor. The employer's viewpoint was advanced by John W. O'Leary, of the Chicago Trust Co. Another speaker was Gov. Allen, of Kansas, who explained the workings of the new Kansas Industrial Court.

A group session was held to crystalize an American viewpoint on questions that will come before the first meeting of the International Chamber of Commerce, which will be held in Paris, France, during the week of June 21 and will be attended by more than 100 American delegates.

It was announced that $2,750,000 has been subscribed or pledged for a new home for the United Chamber of Commerce.

Important resolutions were passed on Increased Production, Peace Treaty; Government and Business, American Institution, Agriculture, Railroads, Merchant Marine, Waterways,Traction Service, Fire Prevention, Governmental Co-operation, War Plans and Equipment, Damages by Government Agencies, Department of Commerce, National Budgets, Taxation, Preparation for Emergencies, Union Chamber of Commerce, and various other subjects.

Resolutions were also recommended to the Board of Directors on Anti-Trust Laws, Business Codes, Cost Accounting, Foreign Trade Policies, Government Foreign Service, Highways, Industrial Courts, Methods of Determining Capital, Public Service Corporations, Selling Prices Fixed by Labor, and various other subjects.

There were elected the following officers: President, Joseph H. Defrees; senior council, Harry A. Wheeler, John H. Fahey, R. G. Rhett, Homer L. Ferguson, and Wallace D. Simmons. For vice-presidents: A. C. Bedford, Wm. Butterworth, Philip S. Tuley, Maynard McFie. For honorary vice-presidents, A. B. Farquhar, Charles A. Nagel, L. S. Gillette. Treasurer, John Joy Edson, and thirty directors from the principal cities throughout the United States.

League of the Southwest.

At the three day session in Los Angeles, last April, of the League of the Southwest, the governors of five states and delegates from all parts of the Colorado River Basin were present and resolutions were adopted to promote the wide development of Colorado River storage and power. Congress was requested to appropriate $50,000 to complete investigations of the Boulders Canyon Reservoir site.

Seventh Annual Trade Convention.

The seventh annual convention, held in San Francisco May 10, was attended by more than 2,000 financial and trade experts. The sentiment of the meeting was strong for the necessity for promoting and increasing foreign trade, and James S. Farrell, of the Steel Corporation, asserted that our productions will be greater than our home consumption and in order to maintain them, they must have foreign outlets. Fred I. Kent, member of the financial committee of the Inter-Allied Preparation Commission, asserted that no government has returned to orderly operations since the war, and that foreign exchanged cannot be stabilized until railroads, shipping, building construction, and all industries are returned to normal conditions, for which maximum efficiency and orderly labor conditions are necessary.

American Water Works Association.

The California section of the American Water Works Association, organized in San Francisco April 20, elected as officers: Chairman, George A. Elliott, chief engineer Spring Valley Water Company; vice-chairman, Charles G. Hyde, professor of sanitary engineering, University of California, and secretary-treasurer, George W. Pracy, superintendent Spring Valley Water Company.

International Association of Fire Engineers.

At a directors' meeting held in Toronto, Canada, March 24, it was decided to hold the next annual convention in the Toronto Exhibition Park, July 26-30. At this convention there will be held a memorial service in the convention hall. Reports of committees and other routine business will be conducted, and discussion will be held on standards, previously printed and distributed to the members. Addresses, papers and discussions will be presented on Organization and Supervision; Organization and Strength of Companies; Fire Department Engineering, including apparatus and minor equipment; Drill Schools, Drills and Training; Discussion of Fire Manual; Building Inspection by Uniformed Members of Fire Departments; Location, Design and Construction of Apparatus Houses; Regulations and Discipline; Water Supply High Pressure System, and Operations of High Pressure Streams. Discussion is important and is especially invited on these reports, particularly that on Fire Department Engineering and Minor Equipment, and on Fire Extinguishers and Fire Prevention. Acknowledgment was made of an invitation to hold the 1921 convention in Savannah.

It was pointed out that the fire waste in this country is between $250,000,000 and $300,000,000 annually, and that between 7,000 and 10,000 people perish by fire each year in North America.

American Railway Engineering Association Elected a Member of Engineering Council.

In accordance with the proposal of chairman J. Parke Channing in a communication to the United Engineering Society dated March 19, 1920, and with the unanimous approval of the representatives of the Founder Societies in Engineering Council, it was voted at the regular meeting of the trustees of United Engineering Society on March 25, 1920, as follows:

"That the American Railway Engineering Association be invited and elected to membership in Engineering Council, subject to the unanimous approval of the governing bodies of the four Founder Societies, and that upon receipt by the secretary of information of such approval, the invitation be extended to said association to become a member of Engineering Council, upon acceptance of the invitation and compliance with the requirements of the Rules for Admission of Additional Societies."

The American Railway Engineering and Maintenance of Way Association was organized in 1899 with the object of "the advancement of knowledge pertaining to the scientific and economical location, construction, operation and maintenance of railroads"; the name was changed in 1911 to its present form and the association now has about 1,640 members. The president is H. R. Safford, M. Am. Soc. C. E., assistant to president of Chicago, Burlington & Quincy Railroad, and the secretary is E. H. Fritch, 431 South Dearborn street, Chicago, Ill.

The Detroit Engineering Society.

The Detroit Engineering Society has voted to join the federation of engineering bodies outlined in the report of the joint conference committee of the National Engineering Society.

The Raleigh (N. C.) Engineering Society.

This society, organized April 19, has elected as officers: W. B. Henderlite, president; W. Z Betts, secretary-treasurer, and L. B. Denmark, chairman of committee on membership and publicity

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PERSONALS

Fellows, A. L., has been placed in United States Office of Public Roads.

Sears, S. P., assistant engineer. division of irrigation investigations, charge of the Denver office of the Hartford Water Department, has accepted a position with C W. Blakeslee & Sons, New Haven, Conn.

Murphy, L. G., has accepted a position with the Foundation Company, New York.

Saville, Thorndyke, professor of hydraulic and sanitary engineering at the University of North Carolina, has been appointed hydraulic engineer for the North Carolina Geologic and Economic Survey in charge of an investigation of water resources of North Carolina.

Schwab, J. C., has been appointed city engineer of Alton, Ill.

Nelson, W. H, has been elected engineer of Smith County, Kansas.

Russel, G. A., has been elected engineer of Geary County, Kansas.

Rumberger, H. K., Bellingham, Wash., has been appointed city engineer of Ferndale, Wash.
Okla.

Victoreen, C. J., has been appointed city engineer of Cabiz, Ohio.

Wood, C. W., has been appointed chief engineer of the South San Joaquin Irrigation District, California.

Clark, B. E., has been appointed district engineer at McAlester, Okla.

Ramsey, E K., has been appointed district engineer at Oklahoma City, Okla.

Forde, L. K., has been appointed district engineer at Cherokee, Okla.

Hunt, C. F., has been appointed village engineer of Endicott, N. Y.

Schark, Frank, Jr., has been appointed to the Missouri State Highway Department at Jefferson City, Mo.

Stevens, J. H., has been appointed village engineer, Massena, N. Y

Preston, J. O., has become assistant engineer to I. K. Davis Company, contractors of engineers, Philadelphia.

O'Brien, F. E., has been appointed assistant city engineer of Watertown, N. Y.

Gould, A. G., has been appointed chief engineer of the H. Denburger Contracting Company, Bethlehem, Pa.

Elliott, W. R., has resigned as chief engineer of the Sault River Valley Water Users' Association, Arizona, and established an independent engineering practice.

Eichelberger, F. O., city engineer of Dayton, Ohio, has been appointed Director of Public Service

New Appliances

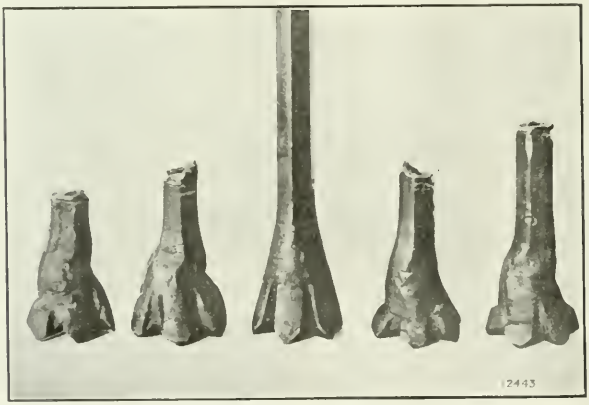
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

IMPORTANCE OF GOOD DRILL SHARPENING.

Success in rock drilling is almost entirely dependent on the care and judgment used by the blacksmith in turning out good steels. The drill steel sharpeners turned out by manufacturers of rock drilling machinery has gone a long way towards making this possible, but they cannot eliminate the personal equation of the blacksmith.

One of the largest manufacturers of the rock drilling machinery not long ago had a complaint that one of its jackhamers was falling down on the job. In the customer's own words, "The drill didn't have any pep." Investigation showed the actual condition of the bits that were being used accounted for the results. The bit shown in the center was made by the manufacturers' representative with the same machine as the other four bits shown, demonstrating clearly that it was not the fault of the sharpening machine. Is it any wonder that the jackhamer didn't have any pep?

It is found that a large number of drill complaints can be traced directly to bad blacksmithing, against which the manufacturers are waging a continual campaign of education.

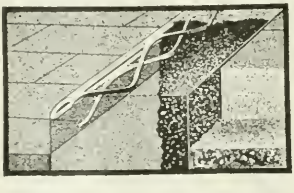


DRILL BITS SHARPENED PROPERLY AND IMPROPERLY BY SKILLED AND UNSKILLED OPERATION OF SAME MACHINE.

NATIONAL CURB (BAR) REINFORCEMENT.

National curb (bar) reinforcement manufactured by the National Steel Fabric Company, is built into the upper exposed corner of a concrete curb in such a manner as to protect the latter from abrasion, impact, cracks, or expansion openings and to present a strong, symmetrical curved bearing surface with an attractive finish. It also serves as an efficient reinforcement for the curb slab itself and gives it additional durability.

The curb bar is a quadrant segment of a hollow cylinder with the upper and lower edges tangent to the face and top of the curb, thus forming a smooth round corner continuous with the vertical and horizontal concrete surfaces. On each edge the metal, in fabrication, is detached from the main body of the bar in long, narrow strips that are separated from it except at the end and are bent inwards, deflected from the surface of the concrete so as to form loops embedded in the concrete and serving as thoroughly efficient anchors to hold the bar exactly in place and providing steel reinforcement for the concrete. They give transverse as well as longitudinal strength, increasing the bending, shearing and tensile efficiency of the curb. Their continuity and interlocking effect prevent the possibility of wedge action which might divide or split the concrete.

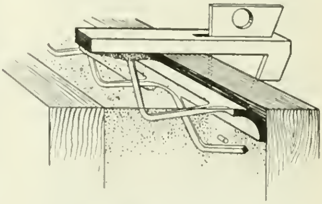


CURB BAR IN POSITION, SHOWING REINFORCEMENT ANCHORAGE.

This device is used not only for sidewalk and pavement curbs, but also for the edges of railroad platforms, warehouse platforms, concrete columns, and, in fact, to protect almost any concrete corner that is exposed to injury in service.

It is manufactured from new billet steel and heavily galvanized after fabrication. It is furnished either in straight lengths or curved to a required radius.

In order to facilitate its accurate and convenient use, the curb reinforcement can be provided with National Curb Bar Clamps, suitable for attaching it to wood forms from 1½ inches to 2½ inches in thickness, and which can be used over and over again, quickly eliminating the first cost. The clamp holds the bars to the forms at the exact required angle until the concrete has sufficiently set, when the clamp is removed and the ½-inch hole that it leaves is filled with mortar. The clamp is easily attached and detached by means of a tapered key, and no screws, bolts, or other fastenings are required for it.



CURB BAR ATTACHED TO WOOD FORM WITH CLAMP.

Ransome Product in Atlanta

Hereafter Ransome concrete machinery in the Atlanta territory will be sold by W. F. Goodrich & Bro., with offices at 10½ Auburn avenue, Atlanta, Ga. For several years W. F. Goodrich has been connected with the Ransome line in this territory. He has recently severed his connection as president of the Piedmont Motor & Machinery Co. and has gone in business for himself with his brother, James Goodrich, who is an experienced engineer. In addition to the Ransome line, they will handle general equipment such as hoisting engines, crushers, forms, etc.

PUBLIC WORKS.

CITY COUNTY STATE

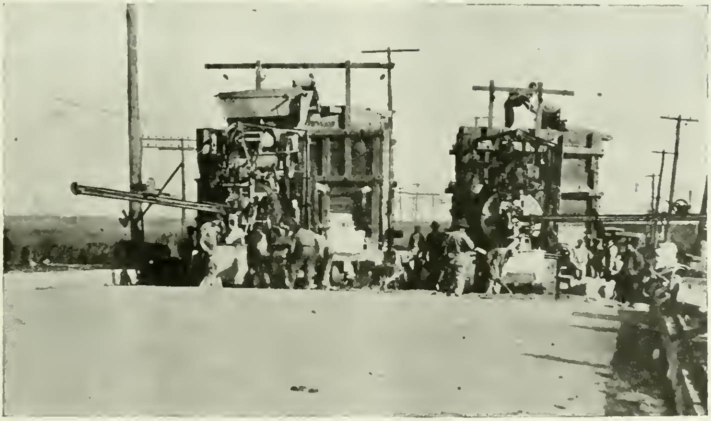
A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, MAY 29, 1920 No. 20

Newark Turnpike Improvement

Building 3½ miles of 40-foot main highway between Jersey City and Newark. Eliminating grade crossings. Longitudinal and transverse drainage on level alignment. Making 300,000-yard embankment on marsh. Handwork in concreting reduced 60 per cent. Duplex concrete plant. Conduits shifted in service.

The Newark Turnpike road, forming part of the main post road from New York to Philadelphia, lies in Hudson county, New Jersey, where about 18,500 linear feet of it, between the Hackensack river and Schuyler avenue, is now being reconstructed and improved under the direction of County Engineer T. J. Wasser, by the Stillman, Delehanty-Ferris Company, New Jersey, contractor. The work was commenced the first of August, 1918, paving was begun about one year later, and the work, which is now well advanced, would probably have been completed during the present year except for unavoidable delays occasioned by scarcity of labor and materials, embargoes and freight congestion.



DUPLEX CONCRETE PAVING PLANT: MIXERS, AGGREGATE BINS AND BELT CONVEYOR ELEVATORS IN REAR.

DESCRIPTION.

The new road will eventually have throughout a granite pavement 40 feet wide on a concrete base with bluestone curbs, and is drained to catch basins 800 feet apart on both sides, which discharge to vitrified pipes from 12 to 30 inches in diameter laid on one side of the road outside the curb line and discharging at different points into creeks. The principal structures are an 8 x 10-foot reinforced concrete culvert 40 feet long for the passage of the waters of Frank creek, several smaller culverts, a crossing over the tracks of the Lackawanna Railroad, a crossing over the trolley tracks on Belleville Turnpike approach, and concrete walls retaining the approach embankments for these crossings.

Most of the road is on tangent, and has maximum curves of about 10 degrees. In general it is made level, with slight artificial grades for drainage. At the Newark end there is a down grade of 1 in 200 for about 400 feet to elevation —7, and there is a succession of low points 800 feet apart at the same elevation. At the center points between these depressions the grade rises to elevation +9. This gives a succession of up and down slopes of $\frac{1}{2}$ of 1 per cent, each 400 feet long, to provide for the flow of water in the drain pipes.

This portion of the road, about 15,000 feet long, is built across the marsh on an embankment 5 feet high above the original surface. This embankment is about 55 feet wide on top, with slopes of 1 on $1\frac{1}{2}$, giving a maximum bottom width of nearly 100 feet. It is pierced by three concrete culverts and twenty cast-iron transverse pipes carrying the drainage from the catch basins on one side of the road to the drain pipe on the other side at low points in the grade. On this fill is laid a concrete base with a wearing surface of granite blocks laid with bituminous joint filler.

QUANTITIES.

The principal quantities include, according to the contract estimate, 304,195 yards of embankment in place, 67,000 square yards granite block pavement, 29,000 square yards Telford macadam pavement (forming a temporary road surface over high fill intended later to become the permanent foundation for the concrete and granite pavements), 14,026 linear feet of vitrified pipe 12 to 30 inches in diameter, 1,300 linear feet cast iron pipe, 16,500 yards of concrete, 32,500 linear feet of bluestone curb, 245,240 pounds triangle-mesh reinforcement for roadway concrete, 15,500 pounds bar reinforcement steel, about 70,000 linear feet of foundation piles and about 250,000 feet of yellow pine and spruce lumber.

TROLLEY SECTION AND DETOUR.

At the west end of the road a double-track trolley line is located on the turnpike and the average difference in grade of the old and new surface is about 3 feet. Here traffic will be maintained on the original alignment without interruption, by constructing the new road in successive longtitudinal halves. A similar process was contemplated for a portion of the road where no trolley tracks are laid, but this idea was finally abandoned except for a total length of about 800 linear feet, as above mentioned, where it was impossible to divert the traffic.

At the Lackawanna crossing the traffic was diverted to a detour constructed in advance of the roadwork and comprising about 1,000 linear feet of macadam built on the original surface of the ground, and about 1,300 linear feet of road built on a pile trestle. After the detours had been constructed and traffic diverted to them, the building of the new embankment on the old alignment was commenced. Construction here was facilitated by the advantageous location of the turnpike between the Passaic river at one end and the Hackensack river at the other end, which permitted nearly all of the embankment and concrete materials to be delivered from barges in the Hackensack river and allowed the embankment to be built from east to west and the concrete foundation to be laid on it as it progressed, while the paving stones were delivered from barges in the Passaic river at the west end of the section.

BUILDING EMBANKMENT.

On a wharf adjacent to the end of the road at the Hackensack river, the contractor installed a stiffleg derrick equipped with clamshell bucket for unloading materials. Most of the embankment fill consisted of cinders hauled in trucks over the line of the road from the east end up to the crossing over the trolley tracks, where the embankment attained a maximum height of about 31 feet above the original surface. The trucks were hired by the contractor and, excepting a few teams employed occasionally, were motor trucks of various types and capacities.

Each truck was carefully measured and numbered and their capacity was rated for water measure or for a 6-inch banking and careful tally was kept on them as they were dumped, the inspector allowing large or small capacity loads or diminishing them if they were not filled to corresponding capacities. Two duplicate slips were made out by which the engineers' and contractors' records were kept. There were in all, at different times, about 600 trucks employed, with capacities ranging from a minimum of 3 yards to a maximum of 14 yards. A number of Pierce-Arrow trucks had their normal measured capacity of 6.8 yards increased to 8.2 yards by the use of side boards. It was found that the smaller trucks could not be employed profitably on this work and they, like the horse-drawn trucks, were generally used only at odd times when they had no other work to do.

About 60,000 yards of embankment at the west end of the road was constructed of sand and loam fill derived from a borrow pit adjacent to the end of the line, where a steam shovel was installed by the Belmont-Gurney Trucking Company, which excavated and delivered the material in a very efficient manner. This company owned a considerable number of trucks employed on other work and whenever a truck was not considered to be in perfect order, it was withdrawn and replaced by one that was in order, and sufficient trucks were always kept in service to keep the steam shovel steadily in operation. If any delays were noticed, the drivers were speeded up, and if this did not suffice, additional trucks were assigned to the work as the length of the haul increased to a maximum of about 2 miles.

The maximum of six 5-ton Pierce-Arrow trucks, which carried 7 yards at a load, were installed and made a record of 25 round trips per truck per day with the minimum haul of only 2 or 3 blocks. The average haul per truck was about 120 to 130 yards in 8 hours. The trucks were equipped with hydraulic dumping lifts and usually distributed the material by advancing slowly as they were dumped, after which the surface was levelled by shovelers and rakers and was compacted by rolling, as specified, with a 15-ton Buffalo-Pitts roller.

The surface of the marsh was irregular and in some places submerged, and the ground was very soft, so that it was difficult to estimate exactly the amount of earth required for the embankment. As a general thing it received about twice as much as indicated by the nominal cross section.

PILE FOUNDATION.

Where the highway passes under the Pennsylvania Railroad tracks, there was so little fill to distribute the loads and protect the surface of the soft ground that the trucks and heavy plant cut through and mired, and it was necessary to drive about 800 lineal feet of full-width pile foundation. Wooden piles 15 to 20 feet long were driven about 5 feet apart on centers in both directions by land machines. The tops of these piles were cut off about 12 inches above water level, the ground was excavated to a depth of 12 inches below the cut-offs, and two ½-inch steel reinforcement rods were laid across the pile tops in each transverse and longitudinal row, after which concrete was deposited around and over the pile tops, forming a platform capable of distributing the load to the piles.

Elsewhere it has not been necessary to make any special provision for settlement, and none of importance has been noticed since the completion of the embankment, the spreading and rolling apparently compacting it so thoroughly that it is subject to little change. Where it was impossible to compact the wide shoulders by longitudinal rolling, a tandem roller operated transversely was used, and this had the effect of causing some lateral displacement of the soil, which resulted in surface movement and in the noticeable tipping of the telegraph and telephone poles.

SHIFTING TELEPHONE CONDUITS.

Near the electric railroad crossing the very important set of conduits containing through telephone wires from the west to Washington were located parallel and adjacent to the alignment, within the limit of the high embankment, and it was necessary to shift them vertically and horizontally and to raise them 5 to 15 feet in a length of about 500 feet. The conduits consisted of 3 tiers of five 3-inch pipes packed together in a rectangle. In changing their position they were supported at intervals of 10 or 15 feet on short cross-beams or slings suspended by differential hoists from light tripods or A-frames. The hoists were simultaneously operated to raise the conduits a maximum of about 12 inches, diminishing to nothing at the ends. While suspended, they were swung transversely clear of their former position and the fill was placed under them, after which they were swung back and the fill placed alongside. They were then hoisted and moved again, and this was repeated until they had been elevated to the required position, aligned and buried. During these operations the conduits developed remarkable flexibility and were sometimes shifted as much as 10 feet out of line without any injury or impairing the service.

RETAINING WALLS.

The high embankments adjacent to the trolley crossings and the Lackawanna Railroad are retained by concrete abutments with wing walls. Adjacent to the Belleville Turnpike there is about 900 feet of face wall on the turnpike side of the embankment, while on the opposite side at this point there was room for the embankment to take the regular slope of 1 on 1½ without retaining. The walls are built on a foundation of spur-braced wooden piles up to 70 feet long, driven in trenches and cut off 12 inches below ground-water level. The tops of the piles project 12 inches into the concrete footing, which is about 12 feet 4 inches wide where the wall has a maximum height of about 32½ feet and has a uniform thickness of 3 feet at the top. The wall is surmounted by a 12-inch coping made 1:2:4, while the mixture in the wall is 1:3:6. Pockets about 4 inches square and 3 inches deep, spaced 8 feet apart, were cored in the coping to receive the lower ends of the pipe rail posts, which fitted loosely in them and were carefully aligned and the holes then filled with cement mortar, holding them rigidly in permanent positions.

The concrete for the walls was mixed in a Lakewood ¾-yard mixer served by trucks, and delivering to a bucket in a wooden hoisting tower about 75 feet high, from which the concrete was spouted through Ransome steel chutes to the forms for maximum distances of about 150 feet. When this length of wall had been completed, the tower was shifted about 300 feet and 300 additional feet of wall was built, and the operation again repeated until the completion of the walls. The towers were shifted easily by means of a stiffleg derrick, which also shifted the concrete mixer at a separate operation.

DELIVERING AGGREGATE TO MOVABLE STORAGE BINS WITH INCLINED BELT CONVEYOR.

At the high end, the retaining walls are connected by a cross wall forming the abutment of the bridge over the trolley tracks. This consists of skew plate girders and I-beams enclosed in concrete and supporting a reinforced concrete slab.

DRAINAGE.

After the grading and embankment have been completed, the cast-iron transverse drain pipes and the vitrified longitudinal drain pipes are laid in trenches 2 feet wider than the external diameter of the pipes and the catch basins and manholes are built.

All pipes are laid on a foundation bed of 2 to 4-

with broken stone and the joints filled with a mortar made of equal parts of portland cement and sharp sand. Manholes have brick walls resting on a concrete footing and containing 8-inch arches for the pipes. The cast-iron manhole heads and covers are extra heavy, proportioned to carry a 7-ton wheel load without injury, and weigh 525 pounds each.

CONSTRUCTING CONCRETE BASE.

Aggregate and cement for the concrete base are delivered from the east end of the road by automobile trucks running on subgrade and supplying the materials only as fast as they are used.

The sand and gravel are delivered on barges at the contractor's wharf on the Hackensack river at the east end of the work. They are unloaded by a clamshell bucket operated by a stiffleg derrick that delivers to the 15-yard elevated loading hopper, under which the trucks pass to receive their loads. No storage is provided on the wharf and the number of trucks is varied to maintain about the required regular supply without excess or deficiency at the mixing machines.

Concrete is mixed in two Koehring paving machines and placed by ¾-inch buckets operated on swinging horizontal booms 20 feet long. Although it would be possible for one machine located in the center of the road to concrete the full width, better results and greater satisfaction are obtained by the use of two duplicate machines working side by side and advancing together. In advance of each machine, on the subgrade, is an elevated, portable, hopper-bottom, wooden storage bin of about 15 yards capacity, which is divided into a small compartment for sand and a large one for broken stone. Each of these bins is mounted on four wide-spaced wheels and is provided with two revolving steel chutes which deliver aggregate from the gates at the bottom of the bins directly to the mixing machine.

In front of each bin there is a gasoline-driven Barber-Green elevating and loading machine having an inclined belt conveyor which reaches from the ground to the top of the bin and overhangs the latter. At the lower end of each conveyor the contractor has constructed a wooden hopper into which the truck dumps its load of broken stone or sand. As some difficulty at first resulted from overloading the conveyors, baffle bars were placed in the bottoms of the hoppers to retard the flow of materials and the opening was governed by a sliding gate which enabled the delivery to the belt to be carefully regulated, after which the operation of the elevator was very satisfactory.

The loading skips for the mixing machines are divided into compartments of the right capacity for the respective amounts of stone and sand required, and thus serve as measuring boxes. They are rapidly filled from the bins by gravity so that the mixing goes on almost continuously. A strip of roadway 18 feet long, containing about 20 yards of concrete, is covered at each position of the mixer, and the mixer is moved about 12 times in one 8-hour shift.

The surface of the concrete is spread to conform approximately to the required cross-section as indicated by a pipe frame template that spans the road and gives the elevation as judged by the eye. The mixer gang consists of about 11 men. The mixing machines move forward by their own power and the stone bins, usually empty at the time, are hauled forward by a cable operated by the 15-ton roller. This arrangement of men and plant reduces the amount of hand labor to a minimum and eliminates fully 60 per cent of what the contractor estimates would be required without the appliances and method above described.

The concrete is reinforced with one thickness of American Steel and Wire Company Triangle Mesh No. 126, which is 54 inches wide and is laid longitudinally with a 6-inch lap and is placed 1½ inches from the bottom of the concrete. The bluestone curbstones, 16 inches deep, 5 inches thick and at least 3½ feet long, have the top edges patent-hammer dressed and are set with a batter of 2 inches and supported on a concrete foundation 6 inches thick and 16 inches wide, connected to the foundation concrete in the front and carried up to within 4 inches of the top of the curb at the rear.

GRANITE PAVING.

The granite paving blocks, delivered by trucks from the Passaic river at the west end of the work, are distributed on the surface of the concrete base and are laid on the latter on a 1-inch bed of coarse, dry sand, all joints lapping at least 3 inches. They are carefully inspected as laid, unsatisfactory blocks rejected, and the pavement rammed to an even surface.

The joint filler is made with equal parts of sand and tar, all of the sand passing through a 10-mesh screen, 75 per cent passing a 40-mesh screen, and 95 per cent refused by a 200-mesh screen. The sand is heated to a temperatures of 250 degrees and tar paving cement to 350 degrees before mixing, and the mixture is flushed into the joints at a temperature of not less than 250 degrees. Special care is taken to have the joints thoroughly dry when filled.

A gang of 6 pavers, 2 rammers, 6 joint pourers and 6 helpers lay an average of 500 linear feet of pavement in 4 days.

TELFORD PAVEMENT.

Where the highway is carried on a high embankment at the approaches to the overhead crossings at the Belleville Turnpike and the Lackawanna Railroad, the depth of fill is so great that it is anticipated settlement may continue for a considerable period. Therefore, to avoid possibility of damage thereby to the concrete pavement foundation, the concreting was omitted for the present, and a Telford macadam roadway will be laid that will eventually serve as the foundation for a concrete base and stone pavement uniform with that on the rest of the road.

After the completion of the embankment to the required cross-section, it is rolled with a 15-ton roller and the top brought to a grade 15 inches below the required road surface. After it has been inspected and approved, the bottom course of broken stones of an average depth of 6 inches is set by hand, the stones being placed on their broadest bases, lengthwise across the road and breaking joints, and are firmly wedged by hand with hammers and projections broken off. Dimensions greater than 10 inches long and 4 inches wide are not permitted, and all flat, smooth surfaces are broken.

The whole surface of the pavement is subjected to ramming with heavy sledge hammers and rolled with a 15-ton roller. A 4-inch course of 1½-inch trap rock is placed, watered and rolled and on it there are spread screenings and loam which are rolled until the stones cease to sink or creep in front of the roller. The surface is finished with about 1 inch of ¾-inch trap rock and screenings in equal proportions thoroughly rolled. This work is accomplished by a gang of about 20 men at the rate of 100 square yards in 8 hours.

The Albany Sewage Treatment Plant

During the first nine months of operation foaming occurred, but was apparently conquered by reversing the flow. The efficiency averaged 67 per cent.

The sewage treatment plant of Albany, N. Y., which is believed to be the largest plant using Imhoff tanks to be found in this country, which was described in the June 17, 1915, issue of Municipal Journal, was put into service about nine months ago. In his annual report for the year 1919, Frank R. Lannigan, city engineer of Albany, briefly summarizes the operation of the plant up to the end of last year. The following is abstracted from this report:

The sewage treatment plant was completed during 1918, but on account of conditions resulting from the war, the beginning of actual operation was deferred until the warm months of 1919 facilitated the beginning of bacteriological action. The sewage was first pumped into the tanks on August 13, two men being started on the same day to go over the line of the intercepting sewer and clean out and open the regulating manholes through which the dry-weather flow of sewage passes from the combined sewers into the intercepting sewer. The flow gradually increased from 5 million gallons a day to 10 million gallons, and by September 18th 15 million gallons were being pumped into the disposal plant.

FOAMING.

On August 28, two weeks after sewage first entered the tanks, septic action started in earnest in tanks 1 to 8, which were those first put into service, this action being evidenced by the marked ebullition of gas in the gas vents. "The heavy matter which the gas raised from the sludge chamber gave off a slight odor. As often as this heavy matter appeared, it was broken up with a wooden dasher. On October 15, this matter, changed in appearance to that of digested sludge, started boiling in the down-stream vents in tanks one and two, the foam rising rapidly and flowing over the vents into the tanks. To overcome this condition, the direction of flow in the tanks was reversed and some of the digested sludge was drawn from the sludge chambers to the drying beds. Three days after this was done, October 24 to October 27, the foam was reduced to twelve inches in depth and in a few days more, it subsided entirely. On November 13, the foam again started, but in the gas vents at the other end of the tanks which, by reversal of flow in the tanks, had become the down-stream end. When it appeared that the foaming would cause these to overflow, the direction of the sewage flow was again changed, more digested sludge drawn off and, as before, the foaming stopped. At the present time there is no evidence of foaming although the ebullition of gas is continuous. The limited experience at the disposal plant so far indicates that reversing the flow and drawing off the digested sludge will stop the foaming, although the stopping may be due in part to increasing cold weather.

OPERATION.

The efficiency of the plant, as determined by the removal of suspended matter from the sewage, has averaged 67 per cent, which is slightly above what was anticipated. During the foaming periods it dropped to 38 per cent, but has risen appreciably since.

There is practically no nuisance caused by odor from the plant as it has never been discernable for a greater distance than 300 yards and then only on muggy summer nights.

The grit chamber is cleaned once a week and it is to be noted that large quantities of cinders and ashes are found in it, which is abnormal and will bear investigation to determine the source. The screen at the entrance to the grit chamber is cleaned four times daily. It catches such things as house cloths, tin cans, garbage, entrails, sticks, etc., which would otherwise clog the pumps.

The disposal of the dried sludge will offer no problem because there is sufficient area adjacent to the plant which can be filled. There have been several inquiries as to its value as fertilizer, but it will require experimentation to make a satisfactory answer. The superintendent of the Bureau of Parks signified his intention to conduct some experiments in the park greenhouses during the winter.

The operating force of the sewage disposal system is now well organized. Up to September 1st the force consisted of three pump operators and one skilled laborer. This force has gradually been increased, as the needs of the system required, to four pump operators, three skilled laborers and eight laborers. Additional men may have to be added in the spring for the work of discharging and disposing of the sludge, maintaining the grounds, skimming the tanks, vents, etc.

Maintaining the intercepting sewer in proper operating condition requires periodic inspection. It is about three and one-half miles in length with nineteen regulating valve manholes besides a number of direct connections. To operate properly, the regulating valve manholes must allow the free flow of dry weather sewage into the intercepting sewer. They are automatic but not in the sense that they do not require attention. After each storm it is necessary to send from two to three men with a push cart over the entire route of the intercepting sewer to make sure that all the regulating valves are in proper working order, because it has been found that they sometimes get partially filled with sand, bricks, tin cans, sticks etc.

Cesspools in Toledo

Toledo, Ohio, had about 240,000 population in 1919. In spite of its large size, a very considerable percentage of its population obtain their drinking water from private shallow wells and live in premises not connected with the sewerage system. How many private wells and outside privy vaults there are is not known definitely, a survey of them now being under way, but in carrying out a campaign to enforce the state regulation requiring the abatement of these, 915 cesspools and 521 surface wells were abolished in 1919 and this is believed to be considerably less than half the number of each. In fact, the sanitary police secured the abatement of 2,178 full and foul vaults and issued 2,095 permits for cleaning vaults and inspected 2,024 foul wells or cisterns. Of 154 samples of surface well water examined by the bureau, 105 were found to contain sufficient B-coli and nitrates to indicate their unfitness for domestic use. The Bureau reports "The gradual elimination of the surface well with the installation of city water, the filling of the open privy vault and the use of plumbing, are having their effect on the typhoid fever rate of the city."

Municipality Owned Asphalt Plants

Additions to the lists of municipally owned asphalt plants which were published in our issues of April 17 and May 1 are furnished by W. E. Rosengarten, traffic engineer of the Asphalt Association. He gives us the names of Jackson, Miss.; Minneapolis, Minn.; Providence, R. I., and Roanoke, Va.

Taylorsville Dam Controlling Conduits

Earth and rock excavated to a depth of 100 feet by electric machine with 2½-yard dragline bucket. Blasted by 100-pound charges of explosive in 4-inch holes, removed in lifts 26 feet high and 37 feet high, and trimmed by small charges, sometimes fired 235 simultaneously. Sand and gravel for 55,000 yards of concrete excavated by dragline machine, washed, screened, and stored in gravity plant. Concrete delivered to forms in bottom-dump buckets hauled on flat cars and handled by derricks.

One of the retarding reservoirs now under construction by the Miami Conservancy Commission to control floods in the Miami Conservancy District is formed by the building of a dam across the Miami river at Taylorsville, Ohio.

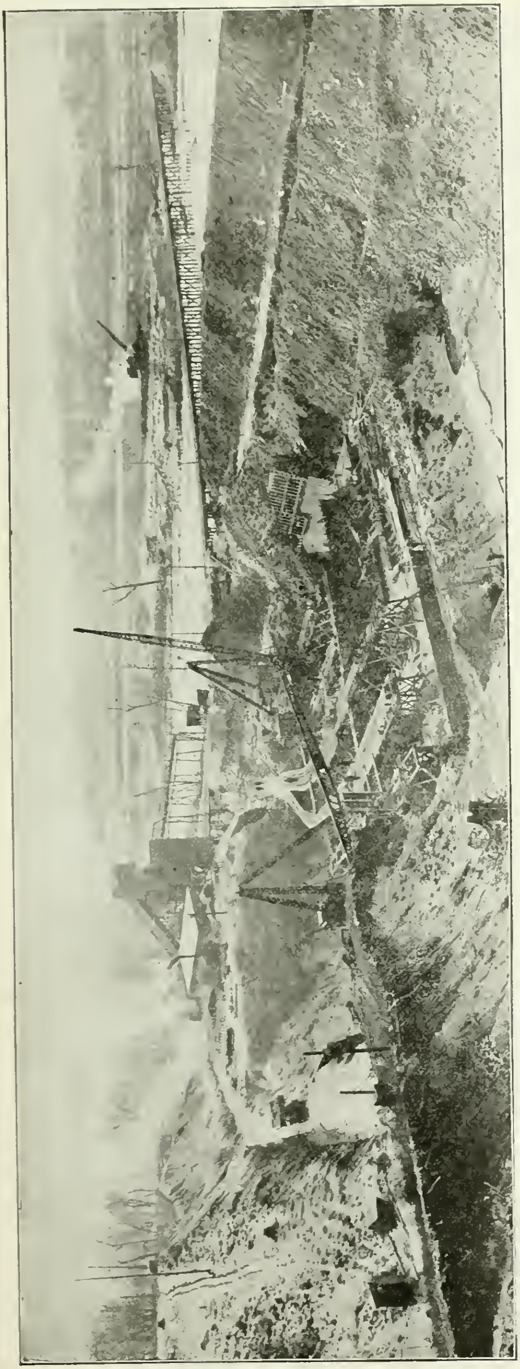
This dam is 2,980 feet long and 59 feet high. It is made of earth and gravel deposited in position by the hydraulic fill method, as described in the article on "Hydraulic Fill Dam Development for Miami Conservancy District" published in Public Works May 8. This method substantially consists of washing sand and gravel by hydraulic monitors from a spoil bank into a sump, from which it is pumped through pipes parallel to the axis of the dam and there discharged (inside successive tiers of protecting levees) and the water so controlled that the deposition of the coarser material carried by it forms massive shoulders on both sides of the dam axis, which enclose a pool in which, before the water escapes, the sediment settles to build up the solid impervious core which completes the cross-section of the dam.

Through the base of this dam there are four duplicate parallel concrete tunnels 15 feet wide and 19 feet 2 inches high, with a united capacity of 55,000 cubic feet per second, sufficient for the maximum flow of the Miami river in a flood 40 per cent greater than that of 1913. These tunnels and the supplementary construction contain 55,000 cubic yards of concrete.

EXCAVATION

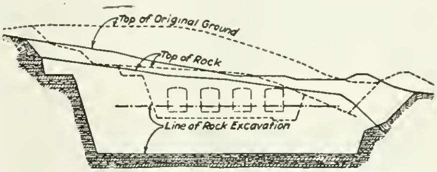
The excavation for the dam foundation and for the tunnels was carried down below the bed of the river and is heavier than that for any of the other four dams in the project. The main trench is 380 feet wide and 1,850 feet long on the center line and 2,900 feet long on the east side. It was carried down to a total depth of 100 feet, 77 feet of which was through rock, involving the removal of 523,000 yards of earth and 250,000 yards of rock.

Although the stripping of the overburden from the rock would have been expedited by the use of a fast-operating steam shovel for the upper part and a dragline machine for the lower part, it was decided that the difficulty of co-ordinating the



double excavation and the installation of track equipment was prohibitive, and only about 30,000 yards was excavated by steam shovel and dragline, loaded into 12-yard dump cars and hauled across the river by locomotives to use for the construction of a cross dam to close one end of the hydraulic pool between the side levees. Up to last January about 230,000 yards of the remainder had been jetted, sluiced and pumped, and these processes will be continued for the rest of the sand and gravel.

The upper 10 feet of the overburden is composed of glacial fill or boulder clay, which was easily excavated. The underlying strata extending 20 feet or more to the rock consist of extremely tough clay or hardpan in which holes, extending not quite to the bottom of the excavation, were made with well drills, sprung with dynamite, and loaded with about one pound of black powder per yard of earth, which, when fired, shattered the material so that it could be handled by the Marion No. 36 steam shovel. The shovel cut a shelf on which was installed a Lidgerwood electric dragline excavating machine equipped with a 100-foot boom and a 2½-yard basket. The steam shovel also excavated about 6,000 yards of rock at an elevation above that on which the dragline machine was installed.



CROSS-SECTION OF EXCAVATION AND CONDUITS.

Holes 4 inches in diameter and 10 feet apart in both directions and not nearer than 5 or 10 feet from the side of the excavation were drilled by two air machines and by three Cyclone machines operated by 7½ h. p., alternating current, 3-phase motors operated at 440 volts, and drilling 50 linear feet per day.

These holes were not sprung, but were charged with 75 to 100 pounds of 72½ per cent gelatine dynamite originally intended for the Italian War Department. About ½ pound of dynamite was used per yard of rock blasted.

The rock was excavated in a 26-foot upper lift extending down to the bottom of the heavy stratum of Cincinnatian limestone, and in a bottom lift of varying height up to 37 feet. The upper lift could not be made higher because, if the holes were carried deeper than the thick stratum, the rock below broke out in blocks so large that it required to be drilled and blasted again in order to reduce it to the proper size for handling by the dragline machine.

After the main lifts had been blasted, the sides and bottoms were trimmed by drilling holes 4 to 6 feet deep with jap and jackhammer drills and loading them with 1 to 2 pounds of dynamite, as many

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The cut in the adjoining column shows the work under way on the controlling works of the Taylorsville dam. The gravel screening tower and mixer are seen at the left; the drag-line machine excavating gravel in borrow pit across river. The steel derricks in the center handle the forms and deposit the concrete in them.

as 235 of these holes being fired simultaneously by an electric circuit supplied with 440-volt current from the motor line.

On this work the dragline machine established a record by operating its bucket at elevations varying from 37 feet above the face of the machine to 65 feet below it. Although its long boom would have enabled the machine to excavate a pit 175 feet wide at the base, the extreme width of this excavation made this system undesirable, and the machine was operated on transverse lines zig-zagging back and forth across the wide trench. The rock was loaded by the dragline bucket into 12-yard dump cars and hauled by 40-ton locomotives to the upper and lower toes of the dam, where it was used for aprons and paving to protect the shoulders and give them additional weight and mass.

CONCRETING

The concreting materials were received, prepared, stored and handled at a plant of standard character similar to those installed at the other dams. Sand and gravel were dumped directly into a track hopper, from which they were elevated by a belt conveyor to a screening and washing plant in the top of a tower, permitting the assorted sizes to be distributed by gravity to elevated bins. These bins discharged fine gravel, coarse gravel and sand through chutes and measuring boxes to a concrete mixer, which was supplied with cement from an adjacent storehouse, from which it was delivered in wheelbarrows. Careful tests were taken and great pains were used to secure and maintain the most suitable sizes and proportion of sand and gravel, to minimize voids and to produce the most satisfactory concrete.

Before the excavation had been completed, forms were placed in the bottom of the finished portion of the pit and concreting was commenced there in the rear of the dragline machine and followed the latter as it proceeded along the trench, thus enabling two kinds of work to be done simultaneously and permitting it to be completed at an earlier date than could have been the case if all the excavation had been finished before the concreting was commenced, as would have been necessary if the steam shovel system had been followed.

The mixer discharged the concrete into 1¼-yard bottom-dump buckets on flat cars drawn by gasoline locomotives on a 3-foot gauge double-track service railroad, installed on low trestles built parallel to the tunnel walls. Two steel stiffleg derricks with booms 105 feet long were installed on each side of the track to unload the buckets from the cars and empty their contents into the wooden forms, which were made in large panels handled by the derricks. Eventually the derrick booms were cut down to a length of 90 feet for greater convenience and rapidity of operation.

In order to continue operations during the cold weather, the gravel screening and washing plant was enclosed to protect it from the frost, and the sand and gravel bins and mixing water were heated by steam furnished by an extra boiler.

This work, which is executed under the direction of Arthur E. Morgan, chief engineer; Charles H. Paul, assistant chief engineer, and T. H. Locher, construction manager, has been the subject of several articles in the Miami Conservancy Bulletin, from which the data has been excerpted for the preparation of this article.

War Department Vehicles for Iowa Highways

During the first ten months of 1920 the Iowa Highway Commission received from the War Department 512 trucks, 37 touring cars, 29 ambulances, 17 tractors, two concrete mixers and a considerable quantity of miscellaneous equipment. Within a very short time 288 of the trucks had been distributed to the various counties and to seven state institutions where there was considerable road maintenance. Of the 512 trucks, 376 were absolutely new. The trucks included one-ton, two-ton and 3½-ton trucks of several makes. An invoice of the material received from the War Department gives it a total valuation of $2,000,000 for the trucks and $500,000 for the other equipment.

In order to store and properly care for these vehicles, a tract of land was leased along the Lincoln Highway near Ames, on which were erected four buildings, 52 by 142 feet, constructed of hollow brick tile, rubberoid roofs and cinder floors. An up-to-date repair shop was established in one end of one of the buildings. The cost of these four buildings was about $43,000.

The title and right of possession to all of the equipment remains vested in the Highway Commission, which assigns it to the counties for use in highway work with the understanding that the counties will maintain it in the best condition practicable, at its own expense.

During the latter part of 1919 a number of trucks had been received without body equipment. As the commission had no money with which to equip them with bodies, the trucks were loaned to Chickasaw county under an arrangement by which the county bought and paid for dump bodies and the cost of these was credited to the county by the commission as offsetting rental.

Probably a few of the trucks will be rented to contractors. Rental rates have been established at 40 cents per ton-hour, plus up-keep and driver's cost. Expense of tires will not be charged against the contractor.

It is expected that this season it will require a crew of about 50 mechanics and helpers to care for the equipment, and that not less than 600 drivers will be necessary for handling the trucks now used by the commission and the various counties.

The commission will retain in its immediate possession 272 trucks to maintain a reserve for replacement and also to provide trucks necessary in case it might become advisable to equip and outfit road building crews.

It is estimated that $24,000,000 more is necessary for the completion of the New York State barge canal.

Hockaday, J. W., has been appointed superintendent of water works at Cleburne, Texas.

Achievements of American General Contractors Association

An official statement of the activities of the organization, the results obtained by it in 1919, and what it is proposing to do in 1920.

According to one of their most recent official publications, this National Association is one of general contractors acting through representative committees on legislation, labor, methods, contracts, ethics, transportation, codes, insurance and bonds, construction, development, etc., to guard and promote the interests of general contractors; to represent their opinions throughout the United States, and to concentrate their action on matters of importance.

It comprises four national organizations or divisions of general contractors: Building contractors, highway contractors, railroad contractors and public works contractors, each acting as a separate unit on matters of special interest, yet in co-operation as members of a single organization.

CLASSIFIED ACTIVITIES

It is operating at present seven services, viz.:

Publication service, including a monthly magazine, weekly news letters, and special reports.

Research service for the investigation of any subject of interest to general contractors.

Legislative service to keep members informed regarding state and national legislation and to represent their interests whenever involved.

Contractors' service corporation to act as agent for general contractors in placing insurance and bonds.

Personnel service to act as an exchange of information regarding available men and positions.

Surplus equipment service to act as an exchange of information regarding available equipment.

Members' and speakers' service to provide speakers for meetings of general contractors.

RESULTS OBTAINED IN 1919

It has organized four national divisions of general contractors and fourteen local chapters, including 445 members, and has held two national conventions.

It has followed the progress of between thirty and forty matters of national and state legislation of interest to contractors; secured the passage of the Relief Bill for Contractors on Treasury Department work; fought the government's interpretation of the bond premium clause in government contracts violating agreements made in good faith; united with engineers, architects and others to form the National Department of Public Works Association to urge the creation of such a department; co-operated with the American Institute of Architects in organizing a national Board for jurisdictional awards; co-operated with the National Safety Council in the promotion of safety practices in construction; co-operated with the National Federation of Construction Industries in conferring with the Railroad Administration on behalf of construction interests; secured the co-operation of the American Institute of Architects and Engineering Council to investigate "Payment for Estimating," and secured the co-operation of the American Association of State Highway Officials in the consideration and adoption of improved highway contract provisions.

It has made an exhaustive study and report on compensation, liability and automobile insurance for general contractors, and has undertaken the investigation of joint conference plans with labor, the application of bonus and profit-sharing plans to construction, rental prices on construction equipment, cost accounting essentials, zoning, changes in building codes, the development of standards for labor and materials in construction, the registration of contractors, improvement in present contract provisions, the base rate on steel, and various transportation rulings and classifications, and it has reviewed and given proper publicity to eleven cases of alleged unfair practices toward general contractors.

THE 1920 PROGRAM

It proposes to secure the passage of a relief bill for contractors on Navy Department work and as far as possible in the several states.

To carry the Bond Premium Case to the highest court.

To secure the passage of a bill creating a National Department of Public Works.

To oppose unwise restriction on immigration.

To oppose the prohibition of cost-plus contracts on government work.

To put the National Board for Jurisdictional Awards on a working basis.

To establish an equitable plan for payment for estimating.

To develop a plan for making comparative studies of standards of labor, material and equipment in construction.

To develop a standard rental schedule of equipment.

To establish a code of practice.

To promote an educational campaign among construction workmen.

To secure the adoption of a definite program of better contract provisions.

To give every case of unfair practice in construction the widest public condemnation.

It is estimated that about $5,000,000 will be necessary for the construction of canals for the irrigation of nearly 200,000 acres of land, most of it in Weber and Ogden River districts, Utah, that will require a storage capacity of 117,955 acre feet, and a high line canal and low line canal system.

Notice of Time of Injury from Defect in Street

By John Simpson

The author discusses the court decisions concerning the definiteness and accuracy with which those suing a city for damages caused by defects in streets must describe, in the formal claim, the time at which the accident occurred.

A usual statutory provision requires, as a necessary preliminary to an action against a municipality for injuries due to defects in streets, a notice of the claim, stating the time and place of the injury, and, ordinarily, the nature and cause thereof. The necessity for a correct statement of the place of injury has already been dealt with in our columns. (*Municipal Journal*, Dec. 21, 1918.) These statutes make the statement of the time just as important as the statement of the place of the accident, and the results of the failure to comply with the requirement because of an erroneous statement of the date of the accident cannot be avoided by saying that the notice is correct in form though erroneous in fact. All the cases on the subject recognize either directly or by implication the necessity not only of *a* statement of the date of the accident, but also of a substantially *correct* statement of that date.

Time is often an important element in the identification of a given transaction. For all practical purposes, an event which begins and ends on any given day is quite distinct from, and quite other than, an event which begins and ends on another day. Doubtless the extent of an injury might with reasonable care be identified without a statement of the time, but since legislatures for reasons of their own have seen fit to prescribe and make essential the statement of the time of the injury, that requirement must be substantially complied with.

The natural and ordinary method of stating the time of an event which begins and ends within the compass of a day is to state the day on which it occurred, together with the month and year, unless more particularity is required by the statute. This is what the legislatures probably intended when the words "time of the injury," with nothing more, are used in the statutes.

The information sought to be furnished as to the time of an alleged accident is, of course, to afford the municipality an opportunity to check up and verify the injured person's movements on that particular date, and to prove, if it can, that he or she was not in that part of the municipality and sustained no injury on the date specified. In order to make the statutory notice effective and of practical value to the city, the language of the statute should be held to be mandatory, and especially as to the true time of the injury. Canter v. St. Joseph, 126 Mo. App. 629; Hackenyos v St. Louis, (Mo.), 203 S. W. 986; Murray v. Seattle, 96 Wash. 646, 165 Pac. 895.

WHEN THE COURT DECIDES.

When the question arises whether the time of the accident is described with sufficient certainty in the statutory notice, who is to determine this question, the court or the jury? If the question is to be determined solely from a consideration of the difference between the time shown by the evidence and that stated in the notice, it should be determined by the court as a matter of law; but if, in deciding the question, it is proper to consider the size of the city or town and the facilities for making investigations as to such accidents, as well as the frequency of similar accidents, and other facts disclosed by the evidence, for the purpose of ascertaining whether the notice given actually served the purpose for which it was intended, and informed the city of the particular accident with such certainty as to enable it to make proper investigation, then it would present a question of fact for the jury. Briefly stated, the rule sanctioned by the weight of authority is that when the time of the injury is shown by the undisputed evidence, and that time differs from the time stated in the notice, the question whether the difference so shown is substantial or material is a question of law to be decided by the court, Ft. Wayne v. Bender, 57 Ind. App. 689, 105 N. E. 949; and it is eror to submit it to the jury; Weisman v. New York, 219 N. Y. 178.

LIMIT OF INACCURACY IN STATING TIME.

What difference between the time stated in the notice and the actual time will make the notice ineffectual? It is clear that where the notice entirely omits to state any time it will be insufficient. Forsythe v. Oswego, 107 App. Div. 187, 95 N. Y. Supp. 33. And the giving of an impossible date likewise makes the notice ineffectual. Batchelder v. White, 28 R. I. 466, 68 Atl. 320. Where the year was omitted, it was held that the notice was defective, although the day and month were stated, and the notice was properly dated. White v. Stowe, 54 Vt. 510. A difference of one month is undoubtedly fatal to the notice. So, where the time in the notice was January 29, 1909, while the accident occurred on December 29, 1908, the notice was held defective. Carter v. St. Joseph, 152 Mo. App. 503, 133 S. W. 851. To the same effect is Ouimette v. Chicago, 242 Ill. 501.

An error of a week has also been held fatal. McHenry v. Kansas City, 101 Kan. 180, 165 Pac. 664. This was a case of alleged injury from slipping on ice on a sidewalk. The notice named January 12 as the date of the accident. Naturally, the court said, the city officials would inquire as to the existence and quantity of ice on the sidewalk on January 12. The accident occurred seven days later. With the variable Kansas winter climate, it was entirely unlikely that the weather conditions of January 12 would be the same as those of January 19. "The time—not necessarily the hour, but the date—is well known by the plaintiff. Therefore the statute requiring the statement to give the time must be complied with. To say that the claimant may name a false and misleading date instead of the correct one—here the discrepancy was a week—'is not,' as the Connecticut supreme court says, 'to construe the statute, but to repeal it.' Gardner v. New London, 63 Conn. 267, 28 Atl. 42 * * * . We note that in Murphy v. St. Paul 130 Minn. 410, 154 N. W. 619, a misstatement of one day in the date given in the notice was held not fatal to a recovery. That was a case where the injury was caused by a defective sidewalk. Perhaps a distinction could be based on that point. A defective sidewalk would remain defective until the fact of the defect could be investigated. Ice on a sidewalk would only remain until the weather moderated.'

In Rauber v. Wellsville (1903), 83 App. Div. 581, 82 N. Y. Supp. 9, it was held, in effect, that the fact that the officers of the municipality were not misled by the notice or that the municipality was not prejudiced by the defect or inaccuracy of such a notice is not material. A notice stating that the injury occurred "on or about" a specified day, the day specified being the true date of the injury, is sufficient. Murphy v. Seneca Falls, 57 N. Y. App. Div. 438; Comstock v. Schuylerville, 139 N. Y. App. Div. 378; Brenner v. Chicago, 182 Ill. App. 348.

Most of the statutes on the subject require that the notice shall "state the time" of the injury, without any qualifying words. Some statutes, such as that of Indiana, provide for "a brief general description of the time," place, cause and nature of the injury. Construing such a statute, it is held, Ft. Wayne v. Bender, 57, Ind. App. 689, that a general statement of the time of the injury would not require a particular statement as to whether the accident occurred in the forenoon, or in the afternoon, or in the evening of a given day, nor would it require any statement as to the hour or the minute of the day upon which the injury occurred; but reasonable certainty requires that the date of the injury, including the year, month and day of the month should be given. The notice, to be sufficiently definite, must, as a general rule, according to the great weight of authority, give the date upon which the injury occurred, and the evidence must conform to the date stated in the notice. A case might arise, of course, where the injury occurred so near midnight of a given day as to render it uncertain upon which of two days the injury actually occurred. In such a case, proof that it occurred within a short time before or after midnight might be held sufficient to support a notice stating that it occurred on either of these days.

A notice stating that the accident happened on the 16th day of April was held insufficient to permit a jury to consider an accident occurring "at any time between the first of April and the last day of May," as this practically allowed of a variance of forty days. Shaw v. Waterbury, 46 Conn. 263. And in a New York case a variance of ten days was held fatal to recovery. Rader v. New York, 97 Misc. 648, 648, 162 N. Y. Supp. 275, and in a very recent case, Weisman v. City of New York, 219 N. Y. 178, 114 N. E. 70, the New York Court of Appeals held that a variance of eight days, between August 20 and August 28, was fatal. A notice that an accident which occurred on the 2nd of May occurred on the 5th of May, an error of three days, was held fatally defective, although the city was not misled thereby. Gardner v. New London, 63 Conn. 267, 28 Atl. 42.

Where "the time" is required to be stated, that is held to mean the day of the injury, and that, it is held, must mean the true day. "There can be only one 'time' of the injury, and that is the one day on which it occurred." If the notice need not set forth the true day, then it may set forth any other day at the whim of the plaintiff, for if the day of the injury is once departed from there is no guide as to what other day shall be stated. The statement of the true day is not only deemed important to the party liable for the purpose of identifying the injury, but also that he may know whether the notice has been given within the proper time. In cases of injury from ice and snow this becomes quite important, because the notice must be given within so short a time after the injury. If the notice may set forth any day as the day of the injury, such a notice as to time is not only useless, but it is positively harmful and misleading. It not only gives no information as to the time of the injury, but it gives false information. The true date must in nearly every case be well known to the plaintiff or to his friends or agents, or it can be easily ascertained, and it is no hardship to require him to state it truly in the notice. Gardner v. New London, 63 Conn. 267, 28 Atl. 42.

A notice which states that the injury occurred on the day after or the day preceding that of its actual occurrence does not constitute a substantial compliance with such a statute. In Benton v. Montgomery (Ala.), 75 So. 473, where a notice which stated the date as December 18, while the injury was sustained on December 17, was held defective, the court said: "If it should be regarded as a sufficient compliance to give notice of a claim as having arisen on the next day after it in fact had arisen, the clear mandate of the statute that the day should be given would be unjustifiably avoided." Hackenyos v. St. Louis (Mo.), 203 S. W. 986; Author v. St. Joseph, 152 Mo. App. 180; Barron v. White, 29 R. I. 482.

THE HOUR OF THE DAY.

In such cases it is not required to state the precise minute or hour of the injury, and according to some courts, this is "all that can be allowed without defeating every conceivable purpose which the statement of the time was intended to subserve." Gardner v. New London, 63 Conn. 267; Lilly v.

Town of Woodstock, 59 Conn. 219; Birmingham v. McKinnon (Ala.), 75 So. 487; Donnelly v. Fall River, 132 Mass. 299; Savory v. Haverhill, 132 Mass. 324; Wilton v. Flint, 128 Mich. 157.

The Alabama statute requires "the day and time" to be stated. Holding a statement that the injury occurred on May 20, 1914, without alleging the time of day, to be sufficient, the Alabama Supreme Court said, McKinnon v. Birmingham, 196 Ala. 56, 71 So. 463: "When the purpose of the statute as above set forth is considered, we are persuaded that a claim, stating a specified day of a given month and year, is a substantial compliance with the statute, and it was not the intention of the lawmakers to require a more specific description, either as to the hour or whether it was night or day."

The Illinois statute on the subject requires the notice to state not only the date but "about the hour" of the injury. In one case under the statute the claimant stated the date but omitted the hour. The action was dismissed, the court saying that it knew of no case which would form a precedent for a court reading a statute which requires a statement of "the date and about the hour of the accident" as though the words "and about the hour" were lacking. Zycinski v. Chicago, 163 Ill. App. 413. Under this statute a statement that the accident happened "some time ago" is not sufficient. Lucas v. Pontiac, 142 Ill. App. 470. And an error of a month in the date is of course fatal. Ouimette v. Chicago, 242 Ill. 501, 90 N. E. 300.

In one notice under the Illinois statute the hour was definitely stated as 5:30 in the afternoon, while the proof showed that the accident occurred at 8:30 in the evening. The notice was held insufficient because, while it is unnecessary under the statute to state the exact hour, but only the approximate hour, yet, "when the statement does undertake to state the hour definitely, and states it definitely wrong, then such statement becomes detrimental instead of beneficial to the city, for the purpose for which it is required by the statute; that is to say, instead of giving the city as nearly a correct idea of the hour as the claimant could give, it suggests a positively incorrect idea on that subject, and so, instead of leading the city to the facts in its investigation, it misleads it. So far as the practical effect is concerned, the city is in no better position than if no hour had been stated, and a failure to state the hour of the accident renders the notice fatally defective." Swenson v. City of Aurora, 196 Ill. App. 83.

CLERICAL ERRORS.

One notice omitted the year, giving the day and month as Tuesday evening, September 28, the notice being dated October 2, 1915. An examination of the calendar showed that September 28, 1915, was Tuesday. The court held, Schmidt v. Manchester, 92 Conn. 551, that the notice was sufficient as it was "hardly conceivable that any person in the exercise of ordinary care and intelligence could have been misled as to the date of the accident because the notice failed to directly state that it occurred in 1915."

Another case of clerical error appears in Canter v. St. Joseph, 126 Mo. App. 629. The notice first stated the date of injury as the 4th of the month, but subsequently referred to it as the 11th, the true date. It was held that this was a substantial compliance with the statute.

DATE NOT REQUIRED BY STATUTE.

Where the statute providing for notice of claim to the municipality does not require a statement of the date of the accident, a mistake in the date of one day will not invalidate the notice, if the municipality is not misled to its prejudice thereby. Murray v. Seattle, 96 Wash. 646; Marcotte v. Lewiston, 94 Me. 233, 47 Atl. 137; Killeleagh v. Brantford, 38 Ont. L. Rep. 35, 32 Dominion L. Rep. 457.

DISCOVERY OF TIME BY MUNICIPALITY.

Apparently, in view of the peremptory language of such statutes, an indefinite or erroneous statement in the notice as to the time of injury cannot be cured by evidence showing that the municipality, through its officers, has obtained accurate knowledge of the time. Ft. Wayne v. Bender, 57 Ind. App. 689; Ouimette v. Chicago, 242 Ill. 501; Carter v. St. Joseph, 152 Mo. App. 503; Gardner v. New London, 63 Conn. 267. In Lucas v. Pontiac, 142 Ill. App. 470, the court said: "It would violate the provisions and defeat the purpose of the statute if the plaintiff was permitted to supply the deficiencies of the written notice by proof that the city or its officers had oral information from her, or from any other source, of the time, place or cause of her injury."

The insufficiency of the notice as to statement of time of injury cannot be waived by the municipality by inquiring into the claim and negotiating for its settlement with the claimant; Batchelder v. White, 28 R. I. 465, 68 Atl. 320; Lucas v. Pontiac, 142 Ill. App. 470; 63 Conn. 267; and it is not waived by the claimant's being examined before trial by the corporation counsel, when she stated the true date. Weisman v. New York, 219 N. Y. 178; 114 N. E. 70.

Jail Inmate Threatens Chicago Strike

"Big Tim" Murphy, now in prison awaiting trial for murder complicity, has written to the Chicago department of public works demanding a wage of $4.20 per day for all street cleaners and threatening an immediate strike if it is not granted. About 1,000 of these men who, it is stated, have been compelled to contribute $1 a month to "Big Tim" to hold their positions, and 4,500 city employes in the street and other departments threatened to go on strike immediately if their demands are not granted. Ashes and garbage removers who have been paid $9 a day demand $11, truck drivers demand $8 minimum, and all street repair men demand a general increase of 25 per cent. If the demands are not met the men threaten to cut off the city's light and water notwithstanding the fact that the city has no money with which it is possible to meet the demands and cannot borrow any until new tax legislation is enacted.

The bill for the licensing of professional engineers and land surveyors in New York State was passed by the Legislature April 24, and signed by the Governor May 14, 1920.

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Damages for Street Accidents

Reports of court cases seem to indicate that more suits are brought against municipalities for the collection of damages on account of injuries caused by alleged defects in streets than of any other one character. The defects include icy sidewalks, projecting flag stones, holes (from minor depressions to large excavations), posts and other obstructions, etc. In defending such suits, a municipality is of course not only justified but bound in duty to the taxpayers to use every precaution to prevent the collection of any damages to which the plaintiff may not legally be entitled.

In providing for the collection of such damages, most of the statutes provide that the city be given sufficient information concerning a claim presented as a basis of suit to enable it to check up the statement of the plaintiff and satisfy itself as to the truth of his statements and justice of the claim. To make this possible, it is generally required that the plaintiff state just where the accident occurred through which his injury was occasioned, what caused it, and the time at which it occurred. Each of these is necessary in order that the city may itself investigate the claim and prepare its defense.

There may easily be some cases in which the time would seem to be unimportant, but there would be others in which it would be very important. For instance, injury on a slippery sidewalk may be claimed to have occurred on a day when the weather conditions made the presence of ice impossible; or contributory negligence might be provable in bright sunlight, although it might not be a justifiable defense if the accident occurred on a very cloudy day or at night.

Because of the frequency of suits of this kind and their consequent importance to municipalities, we published in our issue of December 21, 1918, an article discussing the court decisions concerning the definiteness with which the place where the injury was incurred must be described by the plaintiff. In this issue we supplement this by another discussion of the definiteness and accuracy with which the *time* of the accident must be stated in the notice of suit given to the city. The general tenor of the various decisions cited appears to be that the day, month and year must be given correctly and that failure to do so may form a vital defect in the notice. As to the necessity of stating the hour, the decisions do not seem to be so pronounced, although if an incorrect hour is stated, thus definitely misleading the municipality, this has been considered fatal to the claim. Altogether, it will be worth while for every municipality which is subjected to damage suits of this kind to study these two articles carefully; also it will be advantageous for those about to present such claims to utilize the information there given, in order that their claims may not be thrown out for insufficiency or error.

Pile Foundation for Highways

The concrete on which a pavement wearing surface rests is commonly called the "base," the term "foundation" being less often used. If we consider that there is a technical reason for the distinction made between these words, then a part of the Newark turnpike described in this issue uses its concrete slab as a true foundation rather than a base. For in this case the concrete is reinforced and transmits the traffic loads to foundation piles, with practically no reliance upon the soil for support.

The supporting of a roadway pavement by bearing piles is unusual, and adds considerably to the construction cost. It is justified, however, by the fact that the pavement rests upon unstable marsh land without the intervention of an embankment to distribute either the load upon the soil or the effect upon the pavement of the uneven settlement of the soil; and that the pavement is of a non-flexible type. Probably by no other practicable method could the engineers prevent the occurrence of uneven settling, which would necessitate constant repairing and interference with traffic, the ultimate cost of which would be much greater than this construction. This has been demonstrated by experience with other roads on these New Jersey meadows.

Political Candidates Questioned by Engineers

In this issue of Public Works, announcement is made of two important communications formally addressed by engineering associations to candidates for public office, requesting their replies to a series of questions defining their positions on important subjects relative to public works and policies of various kinds.

These include the creation of a National Department of Public Works; the reclamation of waste lands; budget appropriation of public funds, and engineering representation in the Interstate Commerce Commission, referred to the presidential candidates. Also a series of questions relative to licensing engineers; bond issues for municipal improvements and for good roads; and the improvement of public lands, are submitted to all candidates for public offices in West Virginia.

These questions are all on major subjects of immediate importance to the citizens and should have no political bearing. They have been carefully prepared to indicate, in a conservative manner, some of the positive changes and improvements that should be undertaken and are presented with dignity so that they can readily be answered in the affirmative without constituting unreasonable pledges but will still meet the issue unequivocally and provide a proper basis for executive policy if the candidate is elected.

These questionnaires have the weight of a large number of disinterested, intelligent citizens, many of them professionally associated with the public welfare and especially with public construction, who are entitled to a statement of the views of the candidates asking their suffrages. It will be difficult to refuse a straightforward answer to these questions and, even though some of them may not be answered in the affirmative, the replies will eliminate ignorance and provide a clear basis for the support or opposition of the candidate and for his consistent obligations if elected.

It is, therefore, to be presumed that none of the candidates will fail to reply to the questions and that these replies, perhaps with comments and annotations, will be widely circulated by the proponents of the questionnaires, thus accomplishing considerable missionary and educational good.

This method, conservatively applied by responsible bodies of public spirited experts especially qualified to deal with the topics mentioned, are, we believe, new in the engineering profession and we shall look with interest for beneficial results that should encourage extended action of this sort in future.

Relation of Architects and Engineers to Important Structures

The question whether an architect or an engineer should have charge of the design and construction of bridges and other important structures was brought to the attention of Engineering Council by the American Society of Civil Engineers and by the American Institute of Consulting Engineers. Each organizations had adopted formal resolutions expressing its belief that engineers should have charge of design and construction of bridges and other structures in which engineering elements predominated. Occasion for these resolutions was given by the engagement not many months ago of architects to have charge of the design and construction of certain conspicuous bridges in Pennsylvania. This perplexing problem has been considered by the joint committee of Engineering Council and the American Institute of Architects. Whether engineer or architect has the primary engagement for a project on which the services of both are needed, an important requirement, frequently neglected, is that the collaboration should date from the beginning. Each should be given fair credit for his contribution to the completed structure.

After a full and frank discussion of the points at issue, the committee, composed of three engineers and three architects, all of whom were present, unanimously concluded that the special conditions surrounding each case should determine whether an architect or an engineer should be selected to have charge. The safety, adequacy, durability and suitability to purpose of any structure, whether bridge or building, are axiomatic. Under certain conditions structures should in addition be aesthetically excellent. In such cases the design must involve, therefore, collaboration between engineers and architects. Whether the engineer is chief and the architect associate or vice versa is an administrative detail of relative unimportance. Either combination should secure satisfactory results.

Immigration Increasing

The Washington correspondent of the *Pittsburgh Press* writes that at the present weekly rate the arrival of aliens in the port of New York alone is at the rate of about 625,000 a year. The weekly total, however, is constantly increasing and the 1920 immigration figures may reach 750,000.

The condition is considered remarkable in view of the fact that the failure of the United States to ratify the peace treaty bars all immigration from Germany, Austria, Hungary, Turkey and Bulgaria. The literacy test, now rigidly enforced, also operates to restrict the admission of aliens as well as the wartime regulation requiring aliens to present passports from the governments of the countries from which they are emigrating.

The state department has reports that application of aliens for the vise of passports to this country are rapidly increasing. The largest number of immigrants now is from Italy, Poland, the British Isles and Norway and Sweden sending large quotas of the most desirable class of immigrants.

Frederick A. Wallis, recently appointed Immigration Commissioner, but not yet confirmed by the Senate, says:

"When I become Commissioner of Immigration, the doors of Ellis Island will swing both in and out —in for the oppressed of other lands who have come here with the firm purpose of becoming loyal American citizens and eternally out and impassable for the Reds, anarchists and Bolsheviki.

"What the United States needs is more immigration and immigration of the right kind."

Reports from Malone, New York, immigration officers state that during the war every train from the north brought a large number of immigrants from Canada, but that now the number is very much reduced.

It is officially reported that the arrival of immigrant aliens during the week beginning May 3 numbered 12,674, and deportations numbered 4,310.

A large number of Dutch farmers and their families, bound for Iowa and South Dakota, arrived in New York on the Noordam, May 16.

More than 1,000 Irish immigrants, mostly young men and women, arrived in the port of New York on the Baltic and Caronia, May 19, and report that thousands more are waiting for transportation to this country.

Disposal of Municipal Wastes

By Joseph Goder

Continued from page 446 of the previous issue. In this instalment the author discusses dumping refuse, reclaiming its food value, and utilizing it as fertilizer.

DUMPING OF REFUSE.

The oldest and most obsolete method is to remove the refuse and dump it either at special designated dumps or into the water. This malpractice is still widely used. Not only is this proceedure a nuisance, but it endangers the health of the community. Epidemics of zymotic diseases originate from the refuse dump. Despite better knowledge and continuous warning from state and federal health authorities, even some of our largest cities continue to dump most of their refuse. While the dumping of garbage is generally considered dangerous, the erroneous belief prevails that dumping of rubbish and ashes is a safe, sane and satisfactory proceedure. Rubbish contains a large amount of putrescible matter subject to decay. Rats, flies and other vermin find the rubbish dump a welcome breeding place. The fact that children and also grown up people frequent these places, endeavoring to extract some valuable material, enhances the danger of the rubbish dump. Spontaneous combustion, causing dump fires which are hard to suppress, clearly proves the presence of disintegrating forces in the rubbish pile.

From an economic point of view, the dumping of rubbish must be condemned. It may be cheap in the first place, but will be exceedingly expensive to a town that may be visited by an epidemic of some virulent disease. Rubbish contains, besides an amount of salable material, an appreciable fuel value that can and should be salvaged. Furthermore, as the rubbish dump is generally located a considerable distance from the center of the community, the collection charges are high. A centrally located disposal plant can in some cases be operated for the difference in hauling cost, not to mention the returns derived from recovering the valuable constituents, especially the heat value.

Even the dumping of ashes is not without objection. Ashes commonly contain sufficient organic matter to cause a nuisance. This objection can be overcome by educating the householders to separate the waste carefully. However, ashes contain a considerable calorific value, depending on the nature of the predominating fuel used. Often as high as 35 per cent combustible matter is found in ashes. This represents a value worth while considering. It may in many cases be advantageous to recover this fuel value, especially as in such cases separate collections for the refuse may be dispensed with, thus simplifying and reducing the cost of handling. This fuel value may be used to reduce the cost of disposing of other waste matters.

Thus it is obvious that the practice of dumping refuse can only be recommended in some cases for ashes only. The dumping in water is no less offensive. The organic matter pollutes the water, lighter refuse parts float and contaminate the banks and beaches. Federal laws forbid this disposal in most cases.

RECLAIMING THE FOOD VALUE OF REFUSE.

Much has been written lately of the economic aspects in utilizing the food value to fatten hogs. This method can be used only in disposing of garbage. Rubbish and other refuse have to be separately handled and disposed of. Undisputedly, garbage contains a considerable food value. However, great obstacles must be overcome to exploit this value successfully. The method generally employed is feeding the green garbage to hogs without any other treatment save a superficial sorting of objectionable materials. As only about 30 per cent, never more than 50 per cent, of the garbage will be consumed by hogs, the remains from the feeding ground must be otherwise disposed of.

The fact that this method takes care of the disposal of one part of refuse only excludes its application in medium sized towns, even should a small revenue from this method be expected. These returns, often very problematic, will be fully offset by the necessity to provide means for the disposal of the other refuse, resulting in maintaining separate collection systems. In larger communities, where the amount of garbage is sufficiently large, hog feeding may be investigated, but always the relation of the possible revenue from this proceedure to the increase in cost of disposing of the other material must be considered. Also the sanitary conditions of this disposal means should be carefully weighed before deciding to employ this system.

One very important point to consider is the question of absolute reliability of this method. It takes a great number of hogs to devour the garbage of larger cities and, as the hogs eat in the most favorable cases only 50 per cent of the contents of the average city garbage pail, special provision must be made to dispose of the unconsumed portion. We have seen that this factor upset the satisfactory operation of a hog feeding scheme in one of our large cities. The feeder was forced to change the location of the hog farm three times in less than two years. Plowing under the residues from the feed pens will not help much. Untreated garbage has a very questionable value as fertilizer, especially if used freely. An epidemic among the hogs may paralyze the disposal for a considerable time. Therefore, provision shall be made to divert some or all of the garbage to some other disposal means during such periods. An incineration plant for the disposal of rubbish and other waste will be the most practical means to take care of such emergencies. If necessary, ashes, street sweepings and other less offensive refuse may be diverted from the incineration plant during such periods and disposed of by dumping or otherwise. It is well to consider such condition when deciding on the incinerator installation and to provide for a larger capacity of furnaces. This will be good practice in any event, as a spare unit will materially help to safeguard operation and the additional cost for larger furnace capacity will be comparatively small.

In some instances garbage is cooked or otherwise treated before feeding to hogs or cattle. This procedure has not found great favor. It is claimed that the milk from cows fed with swill or garbage has an offensive taste and is of poor quality. Then the large congregation of stock or hogs necessary to dispose of the quantities, and the long hauls and repeated handling of this putrescible material, are obvious obstacles.

Reports from success of this method must be carefully weighed. In some instances where a high grade of garbage, such as produced in hotels or restaurants, or where the separation of garbage into various grades is done (as in some of the government military camps), feeding of garbage may be in place. However, the serious sanitary objections and the necessity to provide separate collections and disposal systems for the remaining refuse matter favor in very few instances the adoption of feeding garbage directly to animals.

Various attempts have been made to produce an animal food (cattle, hog and poultry) by drying, pressing or other mechanical means. However, so far we have not found any commendable process. Generally the variable nature of the garbage as well as the presence of undesirable material, such as tin cans, glass, crockery, etc., in the garbage can, raise the cost of intended treatment beyond the estimate.

VALUE AND UTILIZATION OF REFUSE AS FERTILIZER.

The basic idea of returning to the soil the organic matter taken from it suggests the utilization of fertilizing value of refuse. Every kind of municipal refuse contains some fertilizing value. However, in the state as collected, most of the waste can not be used directly as fertilizer without some mechanical or chemical transformation. Night soil (where separately collected) and manure are very valuable fertilizer in their natural state and every effort should be made to utilize them. We have encountered cases in small towns in purely agricultural districts of dumping into rivers or cremating as much as 15 tons of night soil per day. This must be considered a grave waste of valuable material. As night soil is separately collected only in communities having only partial or no sanitary sewer system, in rural districts all efforts should be bent to utilize this valuable fertilizer.

Sludge from sewage disposal works, especially the sediment of Imhoff or other bacteriological tanks, is not a very desirable fertilizer in its original state. Lime or other alkali should be added to prevent souring of the ground. Furthermore, sludge in semi-liquid state is difficult to transport without creating a nuisance. Such material must therefore be transformed into a more convenient form, preferably into a dry state, either through pressing or drying. This process, however, is rather costly and will practically annul the financial return from the sale of the finished product. The heat value contained in the sewage sludge promises a better and more commendable factor to exploit.

The fertilizing value of garbage is largely overestimated. Covered with ground, garbage is very slowly assimilated by the soil. If green garbage is to be used as fertilizer, it is preferable from a sanitary point of view, as well as from a utilitarian standpoint, to spread it over the ground in thin layers, permitting a more rapid decomposition under the influence of light and air, stimulating the propagation of bacterial life. The vapors arising by this procedure are far less objectionable than the gases emitted from fields in which the garbage is plowed under. Soil assimilates only a comparatively small amount of garbage without souring and, furthermore, soil treated with garbage must be allowed to oxidize thoroughly before it is in condition for planting.

Garbage, however, can be transformed into a very desirable fertilizer. Garbage and other refuse, such as rubbish and street sweepings, may be finely pulverized. The product of this process, called "poudro" or "poudrette," changes readily into a simpler form, easily absorbed by the earth, especially as it is possible to mix without difficulty products desirable to increase the fertilizer value. This process has been largely used in continental Europe, especially France, but with the development of the incinerator this method became almost extinct.

After extracting greases and oils through a reduction process, the residue, so-called tankage, forms a very desirable fertilizer. This is the most commendable process to exploit the fertilizing value of garbage.

The utilization of the fertilizing value of refuse is rather limited and demands two or more means to dispose of the waste matter, a fact which is of the most importance. Separate collections for the various classes of waste increase the relative cost of collection, demanding attention in estimating the economic side of the problem.

(To be continued)

Motor Convoy from Washington to Los Angeles

Plans have been completed whereby the War Department will send a motor convoy from Washington to Los Angeles over the Bankhead National Highway on or about June fifteenth, due to arrive at Los Angeles September first.

The convoy will be under the supervision of the Motor Transport Corps and will consist of a motor transport unit complete, at war strength, one service park unit, at war strength, detachment from Engineer Corps, and detachment from Medical Corps. All motor trucks will be one and one-half tons capacity equipped with pneumatic tires. They will pass through Virginia, North and South Carolina, Georgia, Alabama, Mississippi, Tennessee, Arkansas, Texas, New Mexico, Arizona and California, ending at Los Angeles.

The purpose of this and other overland trips will be to study the handicaps which surround the transportation needs of the army on account of the lack of dependable and definite systems of highways; to secure data relative to the use of various types of motor vehicles; to secure relative data on solid and pneumatic tires; to train officers and men in extended field operations and to recruit personnel for the various branches of the army.

The Federal Highway Council feels that such study by the Motor Transport Corps will be of great value to the entire country because it will thoroughly establish the necessity of the Federal Government undertaking the construction and maintenance of a definite System of National Highways.

Adapting Highways to Heavy Trucking

T. H. MacDonald, chief of the United States Bureau of Public Roads, states that our whole national road system must be rebuilt with the heavy truck especially in mind. The first thing to be done is to make a traffic survey of the roads of the country, determining just what traffic goes over each class of road, and fixing standards of construction for each class. It is generally agreed that a trunk system of paved roads is the only thing which, in the long run, will serve the purpose. Such roads will be expensive to build in the first place, but not nearly so expensive to keep up once they are built.

The Pennsylvania State Highway Department announces that the receipts of its automobile division up to May 4, 1920, were $6,127,865, showing an increase of $2,112,548 over the same period in 1919. These amounts are very comfortable sums for the encouragement of improved highway construction.

Engineering Platform for Presidential Candidates

The American Association of Engineers has addressed the following letter to the principal candidates for the United States presidency, namely: Major-General Leonard Wood, of Chicago; Senator Hiram Johnson, of California; Governor Frank O. Lowden, of Illinois; Herbert Hoover, of New York; Senator Warren G. Harding, of Ohio; Governor Henry J. Allen, of Kansas; Governor Calvin Coolidge, of Massachusetts; Honorable William Jennings Bryan, of Nebraska; Wm. G. McAdoo, of Washington, D. C.; Governor Jas. M. Cox, of Ohio, and Senator Atlee Pomerene, of Ohio:

Dear Sir:

At the sixth annual convention of the American Association of Engineers last week, a series of six questions was drafted, designed to bring out the position of candidates for President on subjects in which the engineer will be especially interested. A resolution was unanimously passed directing that these questions be sent to all candidates.

The American Association of Engineers is composed of 18,000 professional engineers rather evenly distributed over the country. They wish to help maintain our government on a high plane of efficiency.

If you will kindly answer the following questions at your early convenience, steps will be taken to acquaint our members and the public with your answers:

1—Are you in favor of a National Department of Public Works, for the purpose of reducing and coordinating the present number of bureaus and commissions, and reducing the useless expenditures of money incident thereto?

2—Are you in favor of assembling and coordinating all the engineering and construction enterprises of the government (excepting the purely military works) in a department such as the National Department of Public Works, to the end that economy and efficiency will be obtained?

3—Do you favor the appointment of an engineer of recognized ability and unimpeachable character as a member of the Interstate Commerce Commission?

4—Do you favor the budget system of appropriation of public funds?

5—Do you favor the reclamation of waste lands by drainage, irrigation, flood control or other methods?

6—Do you favor giving the settler the advantage of procuring the land by a sound financial system such as is provided by a rotating fund?

Cordially yours,
(Signed) C. E. DRAYER, Secretary.

Public Works Platform for State Candidates

The Charleston, West Virginia, Chapter of the American Association of Engineers has adopted a resolution requesting all candidates for public office in West Virginia to answer the following six questions:

"(1)—Are you in favor of the enactment of a law for the licensing of professional engineers, architects and land surveyors?

"(2)—Are you in favor of giving greater power to the state board of health, and enacting legislation to remove the present conflict in authority between the state board and local boards?

"(3)—Do you favor providing the state board of health with increased funds to carry out necessary work, such as is now done by all progressive states?

"(4)—Are you in favor of the state acquiring land and taking the lead in reforestation, thus stimulating private interests in the work of reclaiming denuded areas and adding to the wealth and resources of the state?

"(5)—Do you favor submitting to the voters a constitutional amendment permitting cities to issue bonds to at least ten per cent of their assessed valuation, for the purpose of acquiring and operating such self-supporting and income-bearing properties as water works, electrical plants and market places?

"(6)—Are you in favor of amending the constitution for the issuance by the state of $50,000,000 bonds for good roads?"

This chapter has requested the assistance of other engineering and architectural organizations in giving prominence to these questions as a means of developing a public appreciation of the necessity for engineering talent in state administration.

Highway Construction Threatened by R. R. Tieup

The great congestion of freight, the continued inefficiency of the railroads and the issuing of priority orders and embargoes have more and more stopped delivery of the materials for road building and have greatly delayed the highway construction schemes which ought to be in full progress in all parts of the country today.

The lack of materials and plant is not, however, the only drawback to highway construction; although the labor available for this purpose is not adequate, there is enough so engaged as to, in the view of railroad executives, seriously deplete the resources of man-power urgently needed for railroad operation and the advisability of the stoppage of all new highway building and a diversion of its labor to the railroad field in the present emergency is reported to be under discussion with some prospect of important action in the near future.

Maintaining County Highways

Information from counties in many of the states as to cost of maintaining their earth, gravel, concrete, brick, bituminous macadam and bituminous concrete highways, with mileage and traffic of each.

Among the questions submitted by us a few weeks ago to county highway engineers, the replies to most of which have already been published, were certain ones referring to maintenance of highways. The questions asked were the mileage of each kind of road surface in the county in 1919, its average width, the amount spent on it for maintenance during 1919, the average amount spent for each kind of surface per mile per year for a stated period of years, and the nature of travel over the road. This infromation we have assembled in a number of tables, one for each kind of road surface, which tables are presented herewith.

It is, of course, to be expected that the amount spent on maintenance would vary widely in the different counties, because of the great variation both in amount of travel carried and in climatic and other local conditions; also because of the different degrees of repair in which the county was satisfied to see its roads maintained.

It is, of course, quite common for a county to spend comparatively little on maintaining a given road for a year or two, making the necessary repairs at intervals of two or more years. In order to provide for this as far as possible in the maintenance cost figures, we asked our informants to report the average cost per mile per year for as long a period of years as their records would permit. In this way we obtained the averages of from three to ten years in a great many cases. Even these, however, show very wide variations. Concrete, for instance, varied from nothing to $324; brick from $5 to $270; gravel from $20 to $1,080.

In order to allow for the difference in individual

MAINTENANCE OF EARTH COUNTY HIGHWAYS.

State & County.	Mlies in the county.	Average width, ft.	Amount spent in 1919.	Aver. amount per mile per year.	No. of of years averaged	Number and kind of vehicles using road per day—approximate.
Alabama:						
Mobile	1,500	20	......	$30.00	5	Light
Arkansas:						
Polk	100	12	......	3,000.00	..	Ordinary country travel
Florida:						
Bay	100	20	None	Just built	..	Very light
Illinois:						
Christian	17.3	24	$1,434.21	82.90	1	Heavy
De Witt	772	30	65,000.00	96.00	5	....
		..	....	60.00	20	....
McDonough	12	24	1,200.00	100.00	3	500 per day
Schuyler	860	..	55,000.00	....	..	....
Indiana:						
Vigo	356	9	356.00	10.00	5	....
Iowa:						
Appanoose	900	50	15,140.00	....	..	....
Bremer	133	..	12,144.00	....	..	200
Clarke	118.63	24	19,182.76	84.13	7	300 vehicles, 2,500 lb. aver. wt.
Clay	73	26	2,175.58	30.00	3	......
Clayton	206	24	109.05	92.50	5	200 vehicles, mostly autos
Clinton	192	24	26,024.00	62.00	5	......
Decatur	5	26	625.00	....	1	......
Hamilton	900	20	40.00	25.00	10	20 1½-ton
Harrison	168	60	14,600.00	33.00	6	300
Ida	..	26	29,123.16	103.41	4	300 2,000-lb. vehicles
Iowa	35	24	78.69	55.23	5	165
Keokuk	1,231	18–26	66,221.86	53.80	1	1-5,000 vehicles, 4-ton max, with a few 15-ton tractors
Lucas	155	24	10,671.00	8,000.00	5	125 per day—2 tons
Mills	110	28	500.00	175.00	5	Very heavy
Mitchell	120	26	100.00	75.00	5	About 200
Montgomery	928	..	....	35.00	1	Pleasure and heavy trucks, average weight 1½ ton
Muscatine	730 4	24	....	128.00	4	....
O'Brien	1,125	36½	....	50.00	6	Auto & farm to town traffic
Pottawattomie	261	26	66,000.00	230.00	5	....
Sac	110	..	100.00	50.00	3	Medium heavy
Scott	490	24	12,500.00	80.00	5	25 1-ton
Shelby	157.75	26	12,206.50	64.08	5	....
Story	1,160	..	....	160.00	..	....
Van Buren	133	36	15,000.00	....	...	200 varied
Kentucky:						
Graves	730	16	2,000.00	4.00	3	65
Henderson	567	20	24,710.96	45.00	..	....
Michigan:						
Alger	60	16	....	186.11	1	100 touring cars per 24 hours
Luce	12	24	2,400.00	160.00	..	....
Minnesota:						
Chippewa	120	20	107.58	....	..	....
Chisago	115	20	12,150.00	8,200.00	4	50 teams, 100 cars
Clay	168	20	20,000.00	120.00	1	....
Goodhue	94	..	140.00	....	..	....
Grant	95	20	7,000.00	50.00	5	Autos and teams
Lyon	33.5	24	6,878.09	165.00	2	100 2-ton
Nicollet	560	20 to 24	5,950.00	161.00	1	......
Steele	48	18	2,400.00	40.00	5	50-100 per day, light
Stevens	[illegible]	22	7,000.00	....	..	....
Waseca	116	24	113.00	250.00	3	....
Watonwan	97	24	90.00	90.00	3	50
Wilkin	.	..	7,000.00	57.00	1	50% teams, 50% autos, 2,500 lb.

MAINTENANCE OF EARTH COUNTY HIGHWAYS (Continued).

State & County.	Miles in the county.	Average width, ft.	Amount spent in 1919.	Aver. amount per mile per year.	No. of of years averaged	Number and kind of vehicles using road per day—approximate.
Mississippi:						
Jefferson	441	14-18	$48.00-56.00	$40.00	10	....
Pearl River	800	20	45,000.00	52.00	5	10-15
Missouri:						
Camden	159	22	5,000.00	....	..	....
Miller	1,000	20	35,000.00	35.00	4	......
Mississippi	487	24	10,611.68	....	..	....
Ozark	891	20	20,000.00	20.00	5	......
Montana:						
Beaverhead	1,700	16	61,000.00	....	..	Heavy trucks & tourist travel
Carbon	9,000	20	20,000.00	....	..	Farm and tourist
Cascade	2,000	..	27,400.00	....	..	Cars, farm wagons, tractors
Chouteau	560	28	....	75.00	..	....
Flathead	1,600	15	24,500.00	....	..	25 1-ton
Gallatin	1,050	20	75,556.49	40.00	10	1 to 250
Granite	350	14	15,500.00	....	..	....
Hill	1,000	16	25,000.00	....	..	....
Madison	1,300	14	50,000.00	....	..	....
Meagher	158	20	513.50	4.25	3	50 vehicles, light cars, 3-ton trucks, horse-drawn vehicles, heavy tractors
New Jersey:						
Mercer	3.5	..	642.00	....	..	Light farm
North Carolina:						
Beaufort	1,400	20	....	57.00	1	....
North Dakota:						
Barnes	3,000	20	....	25.00	..	....
Ohio:						
Hancock	320.9	10	150.00	....	..	....
Highland	564.6	30	7,000.00	10.00	5	....
Oklahoma:						
Alfalfa	213	30	117.37	117.37	..	....
Choctaw	85	18	27,000.00	....	..	....
Kiowa	210	24	73.00	....	..	....
Oregon:						
Multnomah	138	..	....	100.00	..	....
South Carolina:						
Greenwood	2,200	22	55,000.00	25.00	3	300 2-horse wagons, 1,500 lbs., 100 pleasure cars
South Dakota:						
Beadle	78	20	9,957.70	....	..	350 vehicles, 4% trucks
Custer	43	20	4,000.00	....	..	....
Edmunds	99	40	3,500.00	....	..	....
Gregory	220	20	15,000.00	Negligible	..	....
Meade	200	..	3,000.00	....	..	....
Utah:						
Uintah, Duchesne, Carbon, Emery, Grand & San Juan.	750	18	30,000.00	....	..	Heavy tourist and freighting by teams and trucks
Virginia:						
Wise	120	18	12,000.00	....	..	....
Washington:						
Kittitas	554	24	45,400.00	....	..	....
West Virginia:						
Monongalia	1,000	12	....	100.00	..	....
Morgan	200	16	25,000.00	....	..	100 daily—1½ tons average
Nicholas	16.5	24	1,200.00	70.66	3	90% horse drawn, 100 per day
Wisconsin:						
Brown	900	24	10,000.00	....	..	250 cars
Forest	107	33	....	175.00	..	Very few trucks
Richland	134	..	18,000.00	....	..	....

MAINTENANCE OF GRAVEL COUNTY HIGHWAYS.

State and County.	Miles in the county in 1919.	Average width feet.	Amount spent in 1919.	Average amount per mi. per yr.	Number of years averaged	Number and kind of vehicles per day—approximate.
Alabama:						
Calhoun	23	12	$230	$10	3	Light county travel
Etowah*	100	12	10,000	10	4	200 wagons and cars
Arkansas:						
Sevier	25	14	3,000	12	4	150 autos, 40 10-ton trucks.
California:						
Plumas	150	10	25,000	..	..	Motor vehicles, 9 mos., snowbound 3.
Illinois:						
Carroll	15	12	2,000	..	..	....
Fulton	70	16	....	50	5	Light.
Lawrence	130	9	....	500	1 to 6	100 to 600, all wghts. up to 10 tons
Logan	36	20	1,134†	32	2	....
Schuyler	2	14	600	300	..	....
Wabash	100	9	20,000	..	..	....
Warren	15	15	....	50	12	Heavy
Indiana:						
Delaware	568.5	..	40,800	..	..	....
Henry	371	..	62,696	133.35	3	Up to 280 trucks & touring cars
Jennings	20	10	1,000	10	..	....
Vigo	415	9	415	20	5	250, 1 to 7-ton
Iowa:						
Cerro Gordo	7	16	200	1,080	3	400
Clay	75	14	4.761	75	3	100 local to 900 motor cars
Clinton	14	12	1.892	120	3	400 farm and interurban
Dickinson	70	20	20,000	300	..	2,000 autos
Emmet	38.5	9	18,968‡	85.92	1	300, average weight 2,500 lbs.
Greene	50	8	12,981	..	..	....
Hamilton	74	15	200	150	4	50 1½-ton
Humboldt	45	12	2.500	65	5	....
Mitchell	15	..	....	300	5	300
Palo Alto	2.83	..	....	70	4	250 mostly motor
Sac	40	12	10.000	200	3	Medium heavy
Scott	20	12	3.000	100	5	300, 1½-ton
Kentucky:						
Rockcastle	4	9	50	..	..	40 one-ton

MAINTENANCE OF GRAVEL COUNTY HIGHWAYS (Continued).

State and County.	Miles in the county in 1919.	Average width feet.	Amount spent in 1919.	Average amount per mi per yr.	Number of years averaged	Number and kind of vehicles per day—approximate.
Louisiana:						
10th Ward, Avoyelles	4	14	1,000	250	4	.. ..
Maine:						
Penobscot	15	14	....	60	1	40, average weight 2,800 lbs.
Michigan:						
Cass	93	9	12,436	143§	5	100, 80 3-ton motors
Eaton	225	9 & 12 to 16	40,000	100	5	....
Luce	11	16	3,300	90	..	....
Marquette	27.8	15	10,315	..	.	....
Mecosta	105	12	15,000	130	2	250, 10% horse drawn
Muskegon	50	12	25,000	350**	5	300 mixed
Schoolcraft	5	9	500	100	3	....
Minnesota:						
Aitkin	6	20	16,000	40	8	....
Brown	71	8	13,368	..	.	Light—few trucks
Carlton	91	18	10,000	50‡‡	5	300 autos
Chippewa	16	24	1,721	..	.	....
Chisago	30	20	10,000	312	4	200 cars
Crow Wing	25	18	5,100	125	4	200 to 600 cars
Dodge	16	15	1,872	125	5	Not very heavy
Goodhue	64	18	180	..	.	200 autos, 4 trucks, 14 others
Grant	10	24	3,000	200	5	Autos and teams
Jackson	6	18	5,700	430	3	356 autos, 16 trucks, 88 teams
Kanabec	12	16	....	67	.	.. ..
Kandiyohi	15	20	3,100	430	5	600, mostly cars
Lyon	122	21	16,502	235	2	250 1½-ton
Marshall	22	24	....	55	3	.. ..
Nicollet	250	20 to 24	22,050	225	1	200, 75% touring cars, 5% trucks
Sibley	178	18	17,000	100	1	....
Stearns	30	16	100	90	5	Autos and teams
Steele	64	18	12,500	150	5	200 to 800
Waseca	16	[illegible]	3,200	200	1	300
Watonwan	12	24	2,400	200	2	100
Missouri:						
Callaway	23	9	2,500	30	4	300, average 2 tons
Lincoln	90	9	15,500	210	6	85
Polk	50	9	1,000	25	5	100 2-ton
Montana:						
Granite	20	14	500	..	.	Up to 100
New Jersey:						
Burlington	60	16	....	300§§	..	Heavy
Hunterdon	10	16	2,000	.	..	....
North Dakota:						
Barnes	42	20	2,000	.	.	300
Ohio:						
Ashland	15	12	3,000	..	..	Autos
Champaign	666	10	60,000§	20	10	....
Coshocton	64	16	6,406	..	..	.. ..
Fulton	346	12	6,920	20	..	2 to 8-ton milk trucks
Hancock	95.5	10	500	..	..	....
Highland	303.9	12	30,000‡	60	5	.. ..
Madison	415	15	60,000	100	4	Team and auto trucks
Putnam	61	9	9,500	175	..	.. ..
Shelby	400	14	20,000	40	8	20 2-ton
Tuscarawas	60	20	10,000	..	..	100 touring cars
Tennesse:						
Gills	350	12	124,000	..	..	.. ..
Vermont:						
Bennington	100	20	204	..	.	1,500 autos
Virginia:						
Fairfax	40	16	6,000	..	.	20 miles heavy, balance moderate
Henrico	120	20	5,400	40	3	Wagons
Washington:						
Clellan	77	22	40,000‡	430	2	Touring cars and heavy trucks
Lincoln	114	18	19,000‡	200	5	90%, motor
Pend Oreille	43	20	8,018	150	3	25 to 100 autos and vehicles
West Virginia:						
Summers	20	12	4,000	50	12	100
Wisconsin:						
Adams	2	9	20	10	2	....
Brown	100	9	25,000	..	..	500 cars
Polk	100	9½	39,000	112	1	250
Richland	4	9	400	..	..	....
Rock	300	9	40,250	130	3	.. ..
Trempealeau	15	10	....	65	5	Heavy

Note: Unless otherwise stated, maintenance costs given include only labor and materials. *Gravel and chert combined. †Labor only—own gravel pits. ‡Includes equipment. §Supervision and tools. **Upkeep and depreciation on equipment. ‡‡Includes engineering and supervision. §§Some overhead and some equipment.

MAINTENANCE OF BITUMINOUS CONCRETE COUNTY HIGHWAYS.

State and County.	Miles in the county in 1919.	Average width, feet	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day.
New Jersey:						
Mercer	17	18	$995	...	....	Very heavy trucking.
Passaic	41.9	24 to 20	10,690*	$25*	2	. ...
New York:						
Erie	6.9	16	183†	...	....	....
Otsego	1.0	16	....	150	2	25 per cent. trucks.
Oneida	17.2	20	4,776	349	3	1,945 1¾-ton.
Schenectady	6.4	20	Nothing	...	....	700 2-ton.
Ohio:						
Clark	9.4	16	Nothing.	.	.	....
Muskingum	1.0	14	602	575	...	....
Virginia:						
Fairfax	5	12	500	....	...	Heavy traffic
Washington:						
King	14.4	16	....	1,200	2	1,500 to 2,000.

*$10,000 spent last year on one 2-mile section. †Per mile.

MAINTENANCE OF BITUMINOUS MACADAM COUNTY HIGHWAYS.

State and County.	Miles in the county in 1919.	Average width, feet.	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day—approximate.
Illinois:						
Madison	5	15	....	$600	6	....
Indiana:						
Delaware	23	....	$9,000	....	....	....
Vigo	29	9	....	200	3	1,000, 1 to 10-ton.
Michigan:						
Gogebic	1.5	16	....	900	1	....
Marquette	12.7	15	4,894	....	....	....
New Jersey:						
Hunterdon	10	16	2,000	....	....	....
Mercer	13	18	562	....	....	Medium truck and pleasure traffic.
Passaic	5.9	20 to 30	8,049	1,365	2	....
New York:						
Cattaraugus ...	18	16	474*	....	....	....
Chautauqua	7.7	16	565*	....	....	....
Erie	51.4	16	680*	....	....	....
Niagara	36.7	16	714*	....	....	....
Lewis	46.7	14	5,800	160	2	242 autos, 20 trucks, 25 1-horse, 23 2-horse.
Oneida	100.6	16	35,770	507	3	1,007 1½-ton.
Schenectady ...	30.6	16	13,739	....	....	600 3½-ton.
Ohio:						
Ashland	12.2	10	3,000	....	....	....
Clark	6.5	16	6,000	....	....	....
Fulton	78.6	16	39,290	500	....	....
Highland	24.7	16	30,000	1,000	5	....
Muskingum	3.9	16	4,232	1,075	1	....
Preble	26.7	16	28,560	1,200	5	....
Richland	60	14 to 16	50,000	....	....	....
Shelby	12	16	5,000	500	2	40 5-ton vehicles.
Summit	4.2	16	2,604	940	1	....
Tuscarawas ...	9.1	16	6,800	....	....	150 touring cars.
Virginia:						
Augusta	30	14	6,000	200	4	....
Henrico	14	16	1,400	200	3	Heavy trucks.
Pittsylvania ...	5	20	200*	....	....	....
Wise	20	9	8,000	....	....	250, all kinds.
West Virginia:						
Mineral	8	14	1,200	....	....	....

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*Per mile.

MAINTENANCE OF CEMENT CONCRETE COUNTY HIGHWAYS.

State and County.	Miles in the county in 1919.	Average width, feet.	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day.
Alabama:						
Mobile	1	30	....	$100	5	Heavy.
Illinois						
Carroll	2	10	$200	....	....	....
Douglas	2.1	16	Nothing.	15	5	....
Fulton	5.0	16	....	5	5	Heavy.
Lawrence	5.5	10	....	100	4	200 to 600.
Madison	32.5	15	850	28	6	....
Monroe	1.2	10	Nothing.	....	....	200
Stephenson	1.5	15	70	....	....	200
Indiana:						
Delaware	3	18	Nothing.	....	....	....
Vigo	3	20	3	75	2	1,000, 1 to 10 tons.
Iowa:						
Cerro Gordo....	8	16	28.30	31.80	6	650
Maryland:						
Kent	10	14	150	75	4	....
Michigan:						
Muskegon	2.5	18	75*	40	3	1,200 motor.
New Jersey:						
Burlington	10	18	Nothing.	....	....	Heavy.
Mercer	2	18	244†	....	....	....
Passaic	4.4	30 to 20	....	None.	2	....
New York:						
Cattaraugus ...	30.2	16	203§	....	....	....
Chautauqua ...	25.3	16	240§	....	....	....
Erie	36.9	16	84§	....	....	....
Lewis	8.8	12	500	80	....	Autos, 242; trucks, 20; horse, 48.
Niagara	49.7	16	222§	....	....	....
Oneida	5.5	16	50	128	3	401 1½-ton.
Otsego	15	16	....	230	4	....
Schenectady ...	10.5	16	500	....	....	100 2⅔-ton.
Ohio:						
Ashland	0.5	16	Nothing.	Nothing.	3	Motor cars.
Champaign	2.5	14	200	75	5	....
Clark	15.7	16	15,000	....	....	....
Coshocton	2.1	16	....	100	....	....
Holmes	1.6	12	800	....	....	....
Huron	96.3			30	3	Ordinary farm to heavy trucks.
		10 to 16	1,934			
Madison	3.1	18	100	30	4	Trucks, autos & teams.
Muskingum	12.4	16	4,000	324	1	Very heavy.
Putnam	0.6	16	Nothing.	....	....	....
Richland	9	10 & 14	None.	....	....	....
Shelby	1	16	100	50	2	40 5-ton.
Summit	2.4	17	1,274	5.30	1	....
Virginia:						
Fairfax	8	18	600	....	....	Very heavy.
Halifax	2	16	Nothing.	....	....	....
Washington:						
King	36.7	19	....	1,600*	2	1,500 to 2,000
Lewis	28	8, 16, 18	....	19.49	7	....

MAINTENANCE OF CEMENT CONCRETE COUNTY HIGHWAYS (Continued).

State and County.	Miles in the county in 1919.	Average width, feet.	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day.
West Virginia:						
Mineral	2.2	15	200	....	....	......
Monongalia ..	8	16	80	10	1	100
Pleasants	7	11	300	12	5	Light farm, few heavy trucks
Putnam	1	9	Nothing	..	....	100 1.7 tons
Ritchie	12	9	400		...	100 heavy teams and trucks.
Summers	6	14	100	10	5	Heavy.
Wisconsin:						
Richland	2.7	16	200	....	...	....

*Includes upkeep and depreciation on equipment †Includes administration and truck maintenance. §Per mile.

MAINTENANCE OF BRICK COUNTY HIGHWAYS.

State and County	Miles in the county in 1919.	Average width, feet.	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day.
Florida:						
Hillsborough ..	65	15	....	$28.05	....	....
Illinois:						
Douglas	13	10	None.	10	5	....
Fulton	12	16	....	5	12	Heavy.
Lawrence	1	15	....	100	3	600
Stephenson	2	16	50	....	....	200
Warren	9	10	....	20	10	....
Indiana:						
Delaware	15.5	....	200	....	....	....
Vigo	13	20	13	150	5	1,500 1 to 15 tons.
New York:						
Cattaraugus .	4.6	16	Nothing.	77	3	....
Chautauqua	33.1	16	298*	260	3	....
Erie	114.0	16	366*	270	4	....
Niagara ...	26.6	16	297*	254	3	....
Oneida	1.5	28½	95	108	3	733 1½-ton
Otsego	0.8	16	Nothing.†	....	....	....
Schenectady ...	3.5	18	Nothing.	....	....	....
Ohio:						
Ashland	27.2	10	2,500	....	....	Motor cars.
Carroll	6	16	700	100	3	....
Coshocton	6	16	....	100	....	....
Hancock	18.5	16	500	....	....	....
Holmes	4.8	10	4,700	....	....	....
Huron	22	....	....	3	2	Heavy.
Jefferson	8	....	2,000	....	....	....
Muskingum ...	21.6	16	10,069	467	1	Very heavy.
Richland	7	10 & 14	Nothing.	....	....	....
Summit	58.1	15	74,429	2,190	1	47 5-ton, 34 3-ton, 77 1½-ton, 10 over 5 tons, 3,039 passenger cars, 63 horse.
Tuscarawas	30.4	16	3,000	....	....	20 trucks, 200 touring cars.
West Virginia:						
Monongolia ..	6	16	70	7	3	100 ½ to 10 tons.
Summers	4	20	400	100	5	Heavy.
Washington:						
King	44	18	....	2,000	2	1,500 to 2,000.

*Per mile. †Some needed, however.

ideas as to what constitutes maintenance, the only practicable plan appears to be to make comparisons between costs in individual counties. This could be carried out to only a limited degree, however, because comparatively few counties have more than two or at most three kinds of surfaces on which to report. Taking those reporting on three or more kinds of surface, we find the following figures reported:

Mobile Co., Ala.—Sand-clay $30, earth $30, concrete $100.

Fulton Co., Ill.—Concrete $5, brick $5, sand-clay $25, gravel $50.

Lawrence Co., Ill.—Concrete $100, brick $100, gravel $500.

Vigo Co., Ind.—Earth $10, gravel $20, concrete $75, brick $150, bituminous macadam $200.

Passaic Co., N. J.—Concrete 0, bituminous concrete $25, bituminous macadam $1,365.

Oneida Co., N. Y.—Brick $108, concrete $128, bituminous concrete $349, bituminous macadam $507.

Highland Co., Ohio—Earth $10, gravel $60, bituminous macadam $1,000.

Shelby Co., Ohio—Gravel $40, concrete $50, bituminous macadam $500.

Monongalia Co., W. Va.—Earth $100, concrete $10, brick $7.

Summers Co., W. Va.—Gravel $50, concrete $10, brick $100.

Averaging the reports from all the counties for an average cost per mile per year, including only those where more than one year was reported on, the maintenance costs were found to be as follows, the average cost and the average number of years being given in each case:

Sand-clay—$48, six years.
Dirt—$76, five and a quarter years.
Cement concrete—$128, four years.
Gravel—$153, four and a half years.
Brick—$231, four and a half years.
Bituminous concrete—$431, two and a quarter years.
Bituminous macadam—$493, three and a half years.

One point which attracts notice in this statement is the small number of years for which maintenance costs could be given in the case of pavements which have been in use for many times this number of

MAINTENANCE OF SAND-CLAY COUNTY ROADS.

State and County	Miles in the the county in 1919.	Average width, feet.	Amount spent in 1919.	Average amount per mile per year.	Number of years averaged.	Number and kind of vehicles using road per day.
Alabama:						
Mobile	500	20	....	$30	5	Medium
Florida:						
Bay	15	16	None	....	....	200, 2500 lb
Sumter	50	12	7,000	....	....	50
Illinois:						
Fulton	80	24	....	25	8	Heavy
Marion	8	24	1,200	75	3	....
Iowa:						
Iowa	8	24	36.88*	27.64	5	180
Plymouth	1,500	20	26,840	....	....	....
Maryland:						
Kent	425	33	63.33	50	10	....
Michigan:						
Luce	1	....	100	....	....	....
Marquette	60.3	15	20,898	....	....	....
Minnesota:						
Crow Wing	40	18	5,900	100	....	200 to 500, 1½-ton
Hubbard	128	20	5,888	....	....	400
Kanabec	81	20	....	73	....	....
Missouri:						
Polk	5	14	200	25	10	....
Washington ...	80	....	48.70	....	....	....
Montana:						
Musselshell ...	1,798	26	35,478	....	....	....
Phillips	450	16	10,000	20	1	75 1-ton wagons, 15 1½-ton trucks, 35 autos.
Sanders	608	16	300	....	....	....
Stillwater	1,100	60	35,000	....	....	....
Nebraska:						
Knox	250	28	10,000†	....	....	....
North Carolina:						
Person	50	26	10.000	....	....	....
Wilson	80	....	80*	50	2	....
Ohio:						
Fulton	376.7	....	7,520	....	....	....
Tuscarawas	1,188.6	20	15.000	....	....	.......:.
Oklahoma:						
Potawatomie ..	127	24	12,000	100	4	Little heavy trucking
West Virginia:						
Summers	200	12	5,000	....	....	Light
Wisconsin:						
Juneau	100	12	18.406	....	....	160 1½-ton
Richland	2	14	400	....	....	....

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*Per mile. †Includes machinery.

years. For instance, brick figures were given for an average of only four and a half years, whereas brick pavements have been in use for thirty years in some cities and for ten or fifteen years in a great many cities. Also bituminous macadam figures average only three and a half years and bituminous concrete only two and a quarter years, although hundreds of miles of these kinds of pavement have been in use for ten years and more. The reason for this is undoubtedly that already referred to—that few counties have kept maintenance costs in any detail until within the past three or four years, some are just inaugurating a system of accounts of this kind, and a few of the more backward ones have not yet even reached this point.

One point brought out in the general tables is the considerable number of county officials who are able to give figures, at least approximate, concerning the amount of traffic on roads in their counties. Although a number of the figures given are probably estimates and some may be little more than guesses, it is apparent from the details given in other cases that regular traffic counts have been made.

All of which goes to demonstrate that the science of road construction and maintenance is in its infancy, since a science can be built up only by an accumulation and analysis of known facts, the reliability of the laws deduced increasing with the number of coordinated facts accessible for study; and, up to the present, the facts concerning the behavior of highway materials under various conditions, and even the itemized costs of constructing and maintaining highways of different known characteristics, are deplorably meager.

$2,000,000,000 Strike Loss

F. H. Sisson, vice-president of the Guaranty Trust Company, is authority for the statement that in 1919 the loss from strikes in the United States amounted to $2,000,000,000, including $750,000,000 loss of wages to employes. Mr. Sisson blames strikes for high living costs and increased rents, the latter being due to the fact that organized labor ignores the fact that every time building trades employes strike or shirk their work they increase the cost of building, thus increasing the rents and making higher prices for goods and services of all kinds.

General Wood Favors Selected Immigrants

General Leonard Wood is quoted as saying, "We must give more care to our immigration. We need a certain amount of immigration, but we have a right to know something of the quality of the people who come here. It is not enough that they should be physically sound and of reasonable mental intelligence, but we have a right to know whether they come from the anarchistic group whose religion is destruction and whose object is the ruin of all governments. We do not want this class to come into this country. When these people arrive, I think we ought to hold them for a time under observation. We are glad to welcome the immigrants who come here to adopt our institutions and live up to our standards and ideals. But we should turn our faces against classes of people who are coming here with avowed dislike to our institutions and with declared intention of pulling down our government."

Recent Legal Decisions

CONTRACTS.

CONSTRUCTION AND OPERATION.

The circumstances under which a contract is made, or the intent of the parties existing at the time, are only material when the contract is ambiguous in some of its terms.

(Okl.) However broad may be the terms of a contract, it extends only to those things concerning which it appears that the parties intended to contract.—Wolf v. Blackwell Oil & Gas Co., 186 P. 484.

(Okl.) Under Rev. Laws 1910, c. 12, art. 3, the language of a contract is to govern its interpretation if such language is clear and explicit and does not involve an absurdity.—Wolf v. Blackwell Oil & Gas Co., 186 P. 484.

Under Rev. Laws 1910, c. 12, art. 3, the whole of a contract is to be taken together so as to give effect to every part, if reasonably practicable, each clause helping to interpret the others, and the words to be understood in their ordinary and popular sense unless used by the parties in a technical sense. —Id.

(Mont.) If, upon a reasonable construction, contracts may be upheld, the courts will uphold them. —Helena Light & Ry. Co. v. Northern Pac. Ry. Co., 186 P. 702.

(Or.) Written contracts should be construed from the standpoint of the parties when they were contracting, and be so interpreted as to give effect to all the provisions, if possible.—Dolph v. Speckart, 186 P. 32.

(Vt.) While courts have construed "or" for "and," and vice versa, where such construction was necessary to carry out the manifest intention of the parties, such construction has never been resorted to for the purpose of supplying an intention not otherwise appearing.—Rice v. Bennington County Sav. Bank, 108 A. 708.

(U. S. C. C. A., Okl.) Where the intentions of the parties are clearly ascertainable from the contract and their mutual actions under it, inconsistent expressions in it must be disregarded.—American Refining Co. v. Bartman, 261 F. 661.

(Tex. Civ. App.) Apparent conflicting clauses must be reconciled by a reasonable interpretation, and in case of variance the one which contributes most essentially to the contract is entitled to the most consideration.—Price v. Biggs, 217 S. W. 236.

(Mo.) Where contracts stated that, in case of dispute or "litigation to enforce any of the provisions of this contract. * * * then the notes herein mentioned and this contract shall be construed and interpreted and given force and effect of and by virtue of the existing laws of the state of Texas as interpreted by the courts of said state," the laws and their construction by the Texas courts were as much in the contract as if fully written therein.—Fidelity Loan Securities Co. v. Moore, 217 S. W. 286.

(Tex. Civ. App). A subcontractor is presumed to undertake his work subject to conditions and limitations in the contract between the principal contractor and the owner, if he knows these conditions and limitations; the presumption being conclusive if latter contract is made a part of the former contract.—Hartwell v. Fridner, 217 S. W. 231.

(N. Y. Sup.) Terms implied by legal presumption need not be expressly stated.—Swedish-American Nat. Bank v. Merz, 179 N. Y. S. 600.

(Mont.) The circumstances under which a contract is made are only material when the contract is ambiguous in some of its terms.—Helena Light & Ry. Co. v. Northern Pac. Ry. Co., 186 P. 702.

(Tex. Civ. App.) It is always permissible to show what the parties did under their contract, as disclosing their construction of its purpose.—Eddleman v. Wofford, 217 S. W. 221.

(N. C.) Where a contract is entirely written and intent of the parties is to be collected from the document itself, the construction of the contract is a question of law, and the jury should pass only on the existence of the agreement.—Patton v. Sinclaire Lumber Co., 101 S. E. 613.

(S. C.) Where a written contract was not produced at the trial and the evidence conflicted as to its terms, the effect of the contract presented a jury question.—Allen v. Orr, 101 S. E. 817.

(S. C.) Whether or not there is a contract is ordinarily a question of fact for the jury, but, when the undisputed facts do not make a contract, it becomes a question of law and not of fact.—Capital City Garage & Tire Co. v. Electric Storage Battery Co., 101 S. E. 838.

(Utah) Where the terms of a written contract sued upon are neither ambiguous nor uncertain, it is the duty of the court to construe the contract and to advise the jury of the respective rights of the parties thereunder.—Armstrong v. Larsen, 186 P 97.

CONDITIONS.

(Cal.) The conditions of a written contract may be orally waived.—Walker v. Harbor Business Blocks Co., 186 P. 356.

RESCISSION AND ABANDONMENT.

(Cal.) Where a stipulation does not go to the root of a contract, so that failure to perform would render the rest of the contract different in substance, there is not ordinarily such a breach as will authorize abandonment by the other party, nor is there a fatal breach, where nonperformance of one of the conditions does not materially impair the contract, and may be compensated in damages.—Walker v. Harbor Business Blocks Co., 186 P. 356.

(N. Y. Sup.) To entitle party to rescission of a contract, he must restore what he has received and place the other party in statu quo.—O'Rourke Engineering Const. Co. v. Booth & Flinn, 179 N. Y. S. 623.

(Wash.) A party cannot rescind a contract without offering to put the other party in status quo.—Normile v. Denison, 186 P. 305.

NEWS OF THE SOCIETIES

June 3-4.—NATIONAL STATE AND LOCAL ENGINEERING SOCIETIES. Organizing conference will be held at Washington, D. C.

June 16-18.—NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual convention, Asheville, N. C.

June 19-21.—TRI-STATE WATER AND LIGHT ASSOCIATION. Tenth annual convention, Atlanta, Ga. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS. Asbury Park, N. J. Office of secretary, Philadelphia.

June 22.—JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-Treasurer, D. A. Abrams, Lewis Institute, Chicago.

July 26-30.—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual convention, Toronto, Canada. Secretary, Stephen E. Hoey, Municipal Building, New York.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION. San Francisco. Office of secretary, Boston.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Boston, Massachusetts.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 401 Lincoln Avenue, Valparaiso, Ind.

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New Jersey State Association of County Engineers.

The N. J. State Association of County Engineers recently visited the experimental farm of the Department of Agriculture at Washington, D. C., and inspected the series of field tests being conducted there by the Department of Public Roads. The tests covering "pavement wear sections" were particularly interesting as a device resembling heavy steel-bound traffic was being drawn over sections of pavement laid under various conditions and construction. These results are vastly important to all highway engineers. Another portion of the experiment covered "field impact tests on slabs." Artificial truck impact was being applied to various pavements built in small slabs under various conditions of drainage.

Through the kindness of A. T. Goldbeck, engineer in charge of tests, F. H. Jackson, Jr., assistant engineer of tests, and E. P. Smith, assistant engineer in charge at Arlington, the association spent a very profitable time inspecting the tests being conducted by the Department. The Association feels that the U. S. Governent should allot and provide all the necessary moneys to carry on these vital experiments, because at this time great quantities of money are being appropriated for highway work and it is only by work such as is being done by the men mentioned above that valuable data will be obtained.

American Association of Engineers.

The outstanding sentiment of the delegates and other members attending the sixth annual convention of the American Association of Engineers in St. Louis was a desire for building up strong chapters of the association and for decentralization of some of the business functions.

The chapters are anxious to take over some of the work that has been formerly done at national headquarters, such as passing on qualifications of applicants and collecting dues.

A board of trustees was appointed to consider acquiring a national engineering building in Chicago. It was announced that the city hall square building in Chicago might be purchased.

The same board of trustees will also consider the proposition of providing group insurance for members of the association.

Salaries of teachers in engineering colleges in the United States were recommended tentatively by A. N. Johnson, consulting highway engineer of the Portland Cement Association of Chicago, and Daniel L. Turner, chief engineer of the Transit Construction Commission of New York City, reporting for the committee on salaries of engineers in teaching service, of which Professor C. J. Tilden of Yale University is chairman. The dean of an engineering college is recommended for a salary of from $8,000 to $15,000 per annum, depending on the size of the college; professors, $5,000 to $12,000; associate professor, $4,000 to $9,000; assistant professor, $3,600 to $7,500; instructor, $3,000 to $4,000; assistant instructor $1,800 to $2,400.

Unionism in the engineering profession was strongly condemned in a resolution endorsing a statement issued by the Board of Directors of the association, reading in part as follows: "We believe in organized representation for the correction of wrong, the advancement of the engineering profession, and service to the public, but are opposed to methods inconsistent with the dignity of the profession and which would lessen public confidence in engineers. The American Association of Engineers, recognizing the many fundamental differences between the principles and objectives of the trade union and an organization of professional men, expresses the opinion that an engineer cannot subscribe to the tenets of both." The resolution recommended the expulsion from the association of engineers who advocate strikes or similar methods of securing their ends.

The association also decided to ask candidates for the presidency to declare themselves for or against the proposed national department of public works, for or against a national budget, for or against a constructional program of conservation of natural resources; and for or against reclamation of waste lands.

Another resolution declared that "adequate highway transportation is a prime requisite for the proper development of all sections of our country," and urged encouragement of worthy highway projects and the continuation of appropriations by Congress as Federal aid.

"One of the most important means of stabilizing conditions and values lies in greater individual application and industry," read another resolution, and it was enthusiastically adopted with a pledge that each member would direct his efforts toward the end aimed at by the resolution.

The following officers of the association were elected for the present year: president, L. K. Sherman; vice presidents, H. O. Garman and A. B. McDaniel; directors, Edmund T. Perkins, Charles A. Finley, W. C. Bolin, B. A. Bertenshaw, Professor Frederic Bass of the University of Minnesota, and R. W. Barnes. The next convention will be held in Buffalo, New York.

LOCAL ASSOCIATION OF MEMBERS OF AMERICAN SOCIETY OF CIVIL ENGINEERS.

San Francisco Association. Organized 1905. M. M. O'Shaughnessy, president; Nathan A. Bowers, secretary-treasurer, 502 Rialto Building, San Francisco, Cal.

The San Francisco Association of members of the American Society of Civil Engineers holds regular bimonthly meetings, with banquet and weekly informal luncheons. The former are held at 6 p. m. at the Engineers' Club, 57 Post Street, on the third Tuesday of February, April, June, August, October and December, the last being the annual meeting of the association.

Informal luncheons are held at noon every Wednesday, at the Engineers' Club, where special tables are reserved for members and guests of the association.

The by-laws of the association provide for the extension of hospitality to any member of the society who may be temporarily in

San Francisco, and any such member will be gladly welcomed as a guest.

Colorado Association. Organized 1908. W. C. Huntington, president; A. N. Miller, secretary-treasurer, 14[illegible] West Colfax avenue, Denver, Colo.

The meetings of the Colorado Association of members of the American Society of Civil Engineers (Denver, Colo.) are held on the second Saturday of each month, except July and August.

Atlanta Association. Organized 1912. V. G. Kriegshaber, president; Howard L. Stillwell, secretary-treasurer, 533 Trust Co. of Georgia Bldg., care of Southeastern Underwriters' Association, Atlanta, Ga.

Informal luncheons are held for members of the association on the last Monday of each month, at 12.30 p. m.

Baltimore Association. Organized 1914. H. G. Perring, president, 3206 Carlisle avenue, Baltimore Md.

Cleveland Association. Organized 1914. W. P. Brown, president; George H. Tinker, secretary-treasurer, 516 Columbia Building, Cleveland, Ohio.

The regular meetings of the association are held on the second Wednesday of each month, at 12.15 p. m., in the rooms of the Electrical League, on the fourteenth floor of the Statler Hotel. Luncheon is served at these meetings, and visiting members are invited to attend.

Connecticut Association. Organized 1919. C. M. Seville, president; R. J. Ross, secretary, Municipal Building, Hartford, Conn.

The annual meeting of the association is held in April. The association also holds fortnightly meetings, alternating between Hartford and New Haven, Conn.

Detroit Association. Organized 1916. Lewis M. Gram, president; Dalton R. Wells, secretary-treasurer, 624 McKerchey Building, Detroit, Mich.

The regular meetings of the association are held on the second Friday of December, April and October, the last being the annual meeting.

District of Columbia Association. Organized 1916. David S. Carll, president; James H. Van Wagenen, secretary-treasurer, 719 Fifteenth street, N. W., Washington, D. C.

Duluth Association. Organized 1917. G. A. Taylor, president; Walter G. Zimmermann, secretary, Wolvin Building, Duluth, Minn.

The regular meetings of the association are held at noon on the third Monday of each month (usually at the Kitchi Gammi Club), with luncheon, followed by a short business session and the reading of papers.

National Association of Manufacturers.

At the convention held at the Waldorf-Astoria, New York, May 18, the association adopted "A Platform for American Industry" to be submitted to the Republican and Democratic conventions for incorporation in their national platforms. Before discussing this platform the delegates received the report of the committee on industrial betterment, health and safety which contained a bitter attack on the American Federation of Labor which, it asserted "Brazenly purposes to take the power of the government" by electing a president and congress that will do its bidding." The report referred to Samuel Gompers' defiant challenge to all opposing labor's ambitions in the coming election, and asserted that "labor has openly declared war, and is going to appeal to the public for whom they have no compassion when striking to gain their ends."

The principal planks in the platform are Government and Industry, Regulations of Combination, Private Employment, Relation (upholding individual bargaining) Taxation and Finance, (advocating the repeal of the excess profits tax), Transportation, Immigration (supporting selection and distribution of immigrants), Merchant Marine, Foreign Trade, War Bonus (general and indiscriminate distribution of cash bonus unjustified).

American Institute of Electrical Engineers.

At the annual meeting held May 21 at the building of the Engineering Society, New York, the Edison medal was presented to W. L. R. Emmet.

National Electric Light Association.

The 43rd annual convention of the National Electric Light Association was held at Pasadena, California, May 18-22nd. An important paper on Electric Machinery for All Handling-An Opportunity, by Zenas W. Carter, manager of the Material Handling Machinery Manufacturers' Association, New York, was presented under the auspices of the Electric Vehicle Section and the Commercial Section of the Convention. The paper which was separately published as pamphlet D 5-20, is handsomely illustrated with halftones of various kinds of electric plant in service, including girder cranes, elevators, hoists, industrial trucks, crane trucks, belt conveyors, gantry cranes, telphers, traveling cranes, and other items.

Iowa Engineering Society.

On April 22d and 23d delegates from state and local engineering clubs and societies in Iowa prepared a constitution for the Iowa Engineering Society, a consolidation of all the local technical societies and clubs in the state. The constitution is to be submitted to the different organizations and the vote for consolidation will be closed June 1. The local engineering clubs will become district clubs and will elect applicants to local membership which will entitle them to the membership in the state society.

The society will have an advisory council meeting twice annually to formulate policies and operations for the growth and activity of the society. Their recommendations will be submitted to the annual meetings of the society and if approved, will be carried out by an executive committee composed of the officers of the council who are also officers of the state society.

United Chamber of Commerce.

The U. S. Chamber of Commerce at its annual meeting in Atlantic City, April 26 to 29, elected two engineers as directors of the chamber.

Howard Elliott, member, American Society of Civil Engineers; chairman board, Northern Pacific R. R., New York City.

L. B. Stillwell, past-president, American Institute of Consulting Engineers and of American Society of Electrical Engineers; member, American Society of Civil Engineers; Electrical and Consulting Engineer, New York City.

The Industrial Relations Association of America.

The second annual convention of the above association will be held on May 19-20-21 at the Auditorium Hotel, Chicago. The proposed program announces the following among many other subjects prepared for discussion by prominent men:

Community Conditions Affecting Labor Stability; The Foreman; Wage Levels; Radicalism; Shortage of Labor; Developing the Industrial Relations Staff; Employment Office Methods; Public Utilities.

Organizing Conference.

Engineering societies taking part in the conference at Washington, June 3 and 4, will be entitled to representation there on the basis of one delegate for from 100 to 1,000 members, and not on the basis of one delegate for from 100 to 2,000 members as originally mistakenly announced.

The Boston Society of Civil Engineers announces a field day program at Lake Suntang, Lynnfield, Mass., June 9. The excursion will be by train and auto buses, or by private automobiles. Dinner, dancing and athletic meet are promised.

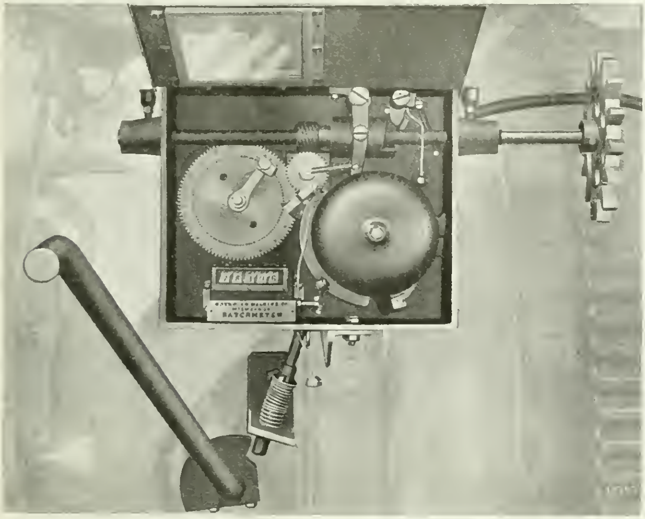
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

KOEHRING BATCH METER.

The Koehring batch meter is a small clockwork instrument that, when attached to a concrete mixer, controls the operations of the latter so as to absolutely determine the time of mixing within fixed limits and records the number of batches mixed.

When the loading skip reaches the charging position and the materials are entering the drum, the meter automatically locks the discharge chute and releases the latter at the expiration of any required period from three seconds to three minutes. This insures uniformity of concrete and regularity and volume of production, and affords a desirable basis of regulation both for engineer, inspector and contractor. The meter tends to prevent lost time by signalling with a gong as soon as the concrete is ready to be discharged, and maintaining the signal until it has been discharged, thus calling attention to any overmixing or idle time when the machine should be running and is not running. The meter can be attached to any mixer and, in combination with an automatic water measuring supply, insures high-grade concrete.



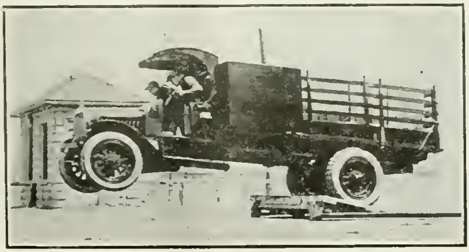
BATCH METER INSTALLED ON MIXER WITH DRIVING PINION ENGAGING MAIN GEAR.

TRUCK AND TIRE TEST.

An interesting test intended primarily to demonstrate the efficiency of the Nobby Cord Truck Pneumatic Tires, which at the same time gave successful results for severe treatment of a two-ton Mack truck, were recently made at the tire factory at Providence, where a two-ton truck weighing 6,400 pounds and carrying a load of 4,400 pounds more, while running on an asphalt pavement, mounted a sharp incline 18 inches high at a speed of 20 miles per hour, jumping 18 feet before it struck the pavement.

The rear wheels were equipped with 8-inch and the front wheels with 6-inch tires, and the jump was made eight times without damaging them in any way. Afterwards the tires were dissected in search of evidence of damage, but none was found. Similar tests, made with a set of tires that had traveled more than 25,000 miles, were equally satisfactory and showed no injury to the tires.

On another occasion Nobby tires on a truck that, with its load, weighed 15,018 pounds were set close to the rails of a track oblique to the truck, so that one front wheel and one rear wheel were in contact with the rails, and when the truck engine was started, the wheels spun around with sufficient friction to make smoke and wear grooves in the wooden ties before the truck finally mounted the rails and moved across them, after which an examination disclosed no injury to the tires.



JUMPING FROM 18-INCH BUMPER AT A SPEED OF 20 MILES PER HOUR.

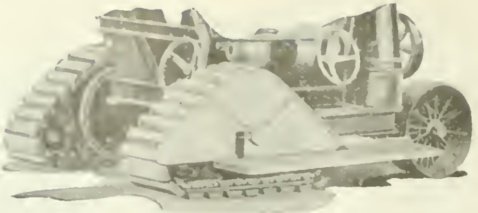
Reduced Waterproof Positive Prints from Tracings

Prints by a new process of duplicating tracings, photographically, known as the "Baker Print," are offered by the American Blue Print Paper Company. The duplications can be made on tracing cloth, paper or any pliable material. Reduced size can be effected, as well as making the prints same size as original tracings.

The duplicate tracings are covered with a waterproofing, the lines being chemically produced in the waterproofing. Corrections on the duplicates are made quickly because the lines erase very easily when removed with erasers, however, they do not wear off on the blue print machines, or from handling.

SMITH PAVER CATERPILLAR.

A novel feature of the Smith Simplex Paving Mixer is the interchangeability of the caterpillar and wheel traction. No changes in the drive, axles or axle brackets are necessary to change from one type to the other. The change can be made quickly and right on the job if necessary.



PAVER MOUNTED ON TRUCK EQUIPPED WITH IMPROVED CATERPILLAR TRACTION.

The caterpillar is of the triangular type, similar in operation to the caterpillar on the British tanks so successfully used in the world war. Inside the caterpillar are three wheels, the upper one of which serves as a tightener, which keeps the parts tightly in line and greatly reduces the wear on the moving parts.

Because of its triangular shape the Smith caterpillar never interferes with the movement of the distributing bucket. The boom can be swung freely at any angle without danger of the bucket coming in contact with the caterpillar.

With a 48x48-inch bearing surface the caterpillar distributes the weight of the paver over the ground at the rate of only 10 pounds per square inch. The height of the caterpillar, over all, is 40 inches; from center line to center line of the idlers is 48 inches. The treads of the caterpillar are made of oak blocks, protected with steel plates. Oversize Babbitt-lined bearings guarantee noiseless, easy propulsion. Idler sprockets are adjustable at both ends for taking up slack.

INDUSTRIAL NOTES.

Announcement by the Portland Cement Association.

J. W. Johnston becomes District Engineer in charge of the Milwaukee Office of the Portland Cement Association.

Mr. Johnston has been with the Association since July, 1916. Before joining our organization he had been City Engineer of Sioux Falls, S. Dakota, County Engineer of Minnehaha County, S. Dakota, and had served in various engineering capacities on railroad and general contracting work. For the past two years, Mr. Johnston has been District Engineer in charge of our Parkersburg, W. Va., Office.

J. H. Riddle, who since 1916 has been connected with the Parkersburg, W. Va., office of the Portland Cement Association, becomes District Engineer in charge of that office, succeeding J. W. Johnston, who has been transferred to the Milwaukee office as District Engineer in charge.

Mr. Riddle is well known in West Virginia, having been for a time County Engineer of Roane County, where he was identified with the construction of some of West Virginia's first concrete roads.

Announcement.

Older & Quinlan announce that their engineering practice has been merged with the practice of Arthur W. Consoer, under the corporate name of the Consoer Engineering Company. Clifford Older is president of this company, George A. Quinlan is secretary and treasurer, and Arthur W. Consoer assumes the duties of vice-president and business manager.

The consulting services of Mr. Older or Mr. Quinlan can be obtained by arrangement with this company, which will also conduct a general engineering practice with executive offices at 1654 Monadnock Block, Chicago.

Municipal paving, water supply, sewerage, drainage, bridges (particularly for cities and drainage districts), reinforced concrete grain elevators, fertilizer, storage tanks, and coal pockets, industrial buildings.

PERSONALS

Harder, H. J., city engineer of Paterson, N. J., has been appointed a member of the New Jersey State Department of Health.

Patstone, L. F., has resigned as city engineer of Manila, P. I., to enter the service of the China Commercial Development Company, Shanghai.

Graff, Major B. H., has been appointed highway engineer of the First Congressional District at Savannah, Ga.

Mitchell, Frank, has been appointed highwa yengineer of the Second Congressional District at Thomasville, Ga.

Caye, Captain W. A., Jr., has been appointed engineer of the Third Congressional District at Americus, Ga.

Smith, G. H., has been appointed engineer of the Fourth Congressional District at La Grange, Ga.

Hawkins, J. W., has been appointed engineer of the Fifth Congressional District at Atlanta, Ga.

Davis, E. H., has been appointed engineer of the Sixth Congressional District at Griffin, Ga.

Simonton, A. A., has been appointed engineer of the Seventh Congressional District, Georgia.

Goodwin, R. T., has been appointed engineer of the Eighth Congressional District, Athens, Ga.

Morgan, H. W., has been appointed engineer of the Ninth Congressional District at Gainesville, Ga.

Sherman, J. S., C. E., formerly with Sanitation Corporation, has joined the staff of the Sanitary Engineering Department of the Dorr Company, 280 Madison avenue, New York City.

Tiffany, R. K., project manager of the U. S. Reclamation Service, has resigned to open a consulting engineering office at Spokane, Washington.

Muldoon, H. R., has opened an engineering office at Spencer, West Virginia.

Read, L. C., has been appointed city engineer of Sandusky, Michigan.

Bayles, G. H., has been made chief engineer and superintendent of construction of the A. J. Krebs Company, builders, Atlanta, Georgia.

Leland, Prof. O. H., College of Civil Engineering, Cornell University, has accepted a position with the J. G. White Engineering Corporation, New York City.

Schlau, Samuel, has opened consulting engineering offices at 318 Greenwich street, New York City.

Mickey, D. D., has been appointed resident engineer of the Federal Aid Road Work in Jefferson County, Kansas with headquarters at Oskaloosa.

Payton, A. D., has been appointed city engineer and secretary of the Board of Local Improvements of Moline, Illinois.

Lawyer, Van E., has been made assistant supervisor of the New York State Highway Department.

Washington, C. C., has been appointed engineer of Galveston County, Texas.

Cheatham, C. V., has been appointed senior highway engineer for the U. S. Bureau of Public Roads in the district of Alaska.

Johnson, V. D., has been appointed engineer in charge of street construction, Roanoke, Virginia.

Seitz, W. K., has been appointed city engineer of St. Joseph, Missouri.

McCamman, J. R., has been appointed surveyor of Eaton County, Michigan.

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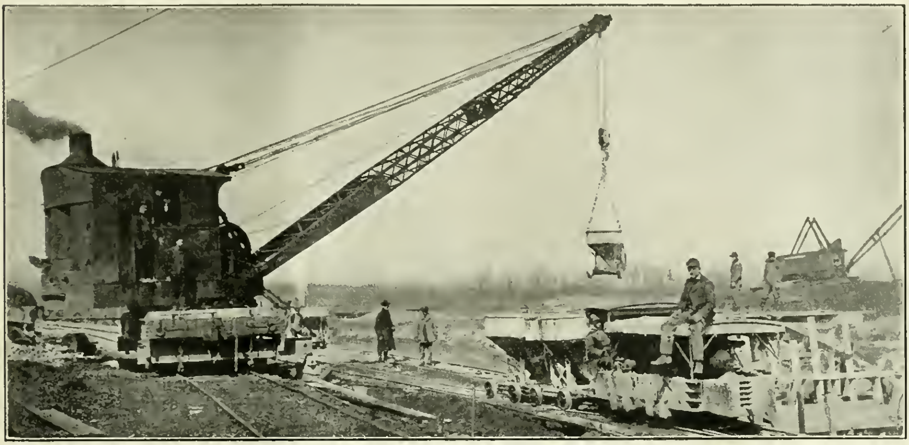
PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48 NEW YORK, JUNE 5, 1920 No. 21



SHIFTING DUMP CAR FILLED WITH CONCRETE TO HIGHER LEVEL, WHENCE CAR CAN DELIVER DIRECTLY BY GRAVITY TO FORMS.

Concrete for Miami Conservancy District Work

Excavating, preparing, grading and storing aggregate. Testing and proportioning materials. Mixing and delivering concrete. Experimental determination of most desirable mixture of sand, gravel and mortar, with tables of voids and density for different sizes of aggregates.

The construction of the five dams for flood control in the Miami Conservancy District involves the use of about 200,000 yards of concrete in the controlling works, which are principally massive structures for tunnels, conduits, spillways, weirs, sidewalls and floors.

As the building of these structures governed to some extent the progress and sequence of other operations, and as they were very large and important elements of each dam, the design and installation of the plants for executing them were of considerable engineering and economic importance. Careful studies were made for the development of substantially uniform practice and standard methods and equipment for the different dams, which varied only as necessary for local conditions and special requirements. Rapidity, reliability and efficiency of operations, simple and economical construction, and a large and constant output at a reasonable cost and with simple methods and apparatus, were the desideratums, which were largely attained by the use of standard equipment carefully combined and arranged.

Hand labor was avoided as much as practicable, gravity methods were used where available, and the operations were made to a large extent simple and continuous. The duration of the work for several years justified the installation of sufficient high-class equipment, some of which will have a salvage value at the end of the work and all of which can be maintained and renewed to the best advantage, while the cost of the items that afford no salvage is distributed over so much time and so large a quantity of work that it becomes an insignificant factor of unit cost.

GENERAL FEATURES.

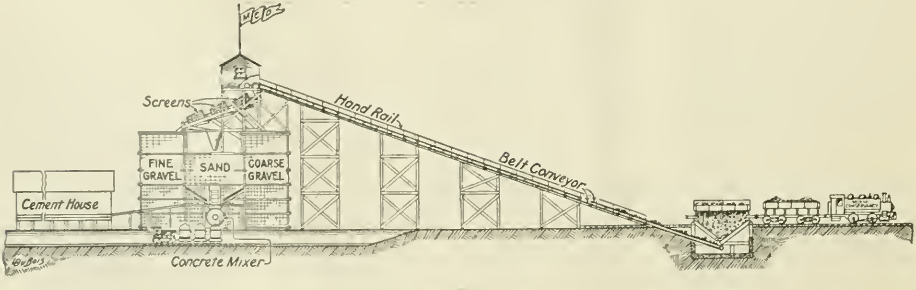
Sand and gravel are derived from the necessary excavations or from borrow pits and are usually secured by the operation of large dragline excavating machines working on dry land or under water, according to local conditions. The sand and gravel are loaded by the excavating machine into 12-yard air dump cars hauled in trains by locomotives and deposited in stock piles or dumped directly into a track hopper delivering to the foot of an inclined belt conveyor supported on wooden trestles. This belt conveyor carries the material to the top of the concrete tower, where it is run through a series of assorting and washing screens which separate the large stones, coarse gravel, fine gravel and sand. All except the rejects are deposited in separate bins having chutes through which the contents are delivered by gravity to adjustable measuring boxes, through which they pass to the charging hopper of a 1-yard Smith tilting mixer installed in the center of the lower part of the tower, directly under the sand bin.

The mixer is at an elevation high enough to permit the mixed concrete to be discharged directly from the machine to conveying chutes or, when these are not available, the machine discharges into 1¼-yard steel concrete cars hauled by a 3-ton Plymouth gasoline locomotive on a 36-inch gage service track. When the cars cannot dump directly into the forms, they are lifted bodily from the track to a higher elevation by locomotive cranes. In some cases the mixer discharges through a short trough to a bucket in the top of a wooden hoisting tower, where it is emptied into a receiving hopper which feeds a line of suspended chutes conveying it to the forms, or to distributing hoppers, whence it is wheeled to the required position.

At the Taylorville dam, the 55,000 yards of concrete required is more than the amount mixed at any of the other dams. In some cases the mixer discharges directly into bottom-dump steel buckets on flat cars hauled to position by locomotives. At the Lockington dam, the controlling works containing about 38,000 yards of concrete have massive conduit walls, 82 feet high and 500 feet long, built with concrete delivered in buckets drawn by Fate gasoline locomotives and handled to the forms by steel derricks with booms 105 feet long. The plant here, like the others, has a capacity of 300 yards in one 10-hour shift. The total length of the mixing, screening, washing and storage plant is 675 feet and its height is 64 feet. The cement house is 100 feet long, the gravel washer and hopper is 215 feet long and the 20-inch belt conveyor is 360 feet long.

DUMPING GRAVEL TO HOPPER OF ELEVATOR AT SCREENING AND WASHING PLANT.

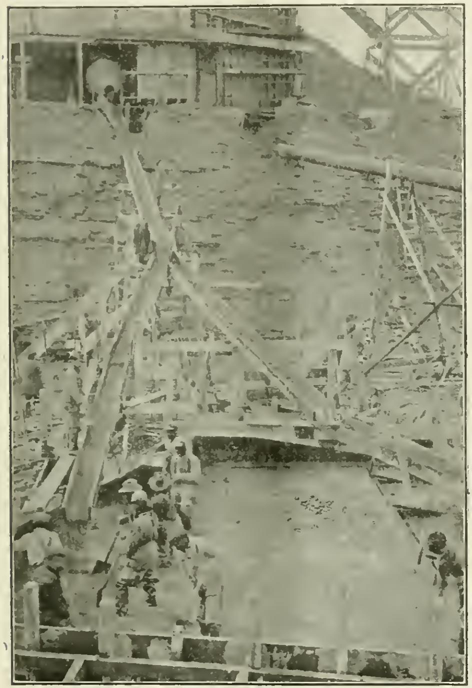
Three conical screens of perforated steel plates are mounted on shafts inclined about 15 degrees from the vertical, and the sand and gravel are delivered to the large upper end of the highest screen. The materials are thoroughly wet with water jetted into the lower ends of the screens and the revolution of the screens separates the materials into coarse gravel from 1½ to 3 inches in diameter, fine gravel from ¼ inch to 1½ inch, and sand less than ¼ inch in diameter, all of which flow from their respective screens through chutes to three large storage bins, the oversize material (from 3 to 6 inches in diameter) being rejected by the screens. In the deposits used for the concrete aggregate the



STANDARD SAND AND GRAVEL WASHING AND SCREENING AND CONCRETE MIXING PLANT.

amount of fine gravel generally exceeds that of coarse gravel by an average of about 50 per cent, although the proportion varies considerably and occasionally pockets of fine or coarse material are encountered as the stratum changes.

Occasionally there are found pockets with an excess of buckshot sand or pebbles, where the larger grains preponderate and make an unsatisfactory concrete mixture. When the excess is not too great, the extra amount of buckshot or pebbles is removed by dimishing the force of the washing water in the lower screen and thus permitting the gravel to slide down the revolving screen while the sand drops through the holes. The longitudinal motion of the sand being thus accelerated, not so many of the particles pass through the holes. The buckshot thus enters the fine-gravel bin over an inclined screen which delivers it into a car on the gravel track, while the larger particles go to the measuring box. When the waste by this method is too great, excavation is shifted to another part of the sand and gravel pit where the proportion of fine and coarse material is more satisfactory. This change is made more easily because the unsatisfactory material usually is found in the lower strata, so that shifting to a higher stratum is effective.



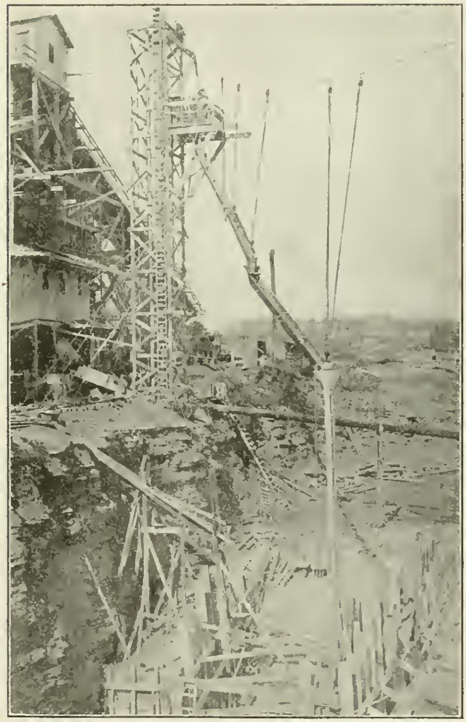
CHUTING CONCRETE DIRECTLY TO POSITION FROM ELEVATED MIXER.

ELIMINATING VOIDS IN AGGREGATE.

In order to determine the best proportions of fine and coarse gravel, sand, and cement, a special investigation was made of the materials used at the Taylorville dam, where 55,000 yards of concrete were required. Tests and investigations made by assistant engineer H. R. Daubenspeck formed the subject of an article published in the March issue of the Conservancy Bulletin, from which the information here presented was secured.

The relative proportion of fine and coarse gravel required to secure the minimum amount of voids and the maximum density of the concrete was determined by mixing carefully measured amounts of fine and coarse gravel in the regular concrete mixing machine. The measuring boxes used for charging the regular run of concrete to the mixer were calibrated so as to determine the exact quantity of materials in each charge, and after they had been mixed, they were dumped in a 51x52-inch rectangular box 24 inches deep, the upper surface of the contents leveled and its height accurately determined by measuring down to it from a straightedge across the top of the box. The volume of mixed aggregate having been thus calculated, the voids were determined by filling a vessel of 2½ cubic feet capacity with the mixture and then adding to it all the water that it would hold, poured from a 10-quart measure marked to gauge fractional proportions.

A set of 4 experiments, recorded in Table I,



SPOUTING CONCRETE FROM HOISTING TOWER TO FORMS.

Table I, voids and densities of mixtures having different proportions of large and small gravel.

Test No.	Coarse Gravel 1½" to 3" cu. ft.	Coarse Gravel 1½" to 3" % of mix	Small Gravel 1¼" to 1½" cu. ft.	Small Gravel 1¼" to 1½" % of mix	Total Volume Before mixing cu. ft.	Total Volume After mixing cu. ft.	Ratio of mix to original volume (%)	% of voids in mix
1	16	50.0	16	50.0	32	25.8	80.6	34.8
2	14	46.7	16	53.3	30	25.0	83.3	36.7
3	12	40.0	18	60.0	30	25.8	86.0	36.7
4	10	35.7	18	64.3	28	25.0	89.3	36.7

Table II, effect of proportion and moisture of sand on volume of aggregate.

No. of Test	Coarse Gravel. cu. ft	Fine Gravel. cu. ft.	Sand. cu. ft.	Volume Mixed. cu. ft.	Remarks
5	16	16	14	34.4	
6	16	16	13	36.7	
8	12	18	13	33.6	Sand Damp
9	16	16	10	32.1	Sand More Damp
10	16	16	13	30.5	Sand Saturated

Table III, size of sand determined by sifting.

Screen No.	6	10	20	35	65
Diameter of wire	.036	.035	.0172	.0122	.0072
Size of opening	.131	.065	.0328	.0164	.0082
Test No.	Percentages of total amount of material that passed through screens.				
1	90%	78%	63%	22%	2%
2	85	72	66	23	3
3	81	67	56	23	2
4	74	58	34	10	3
5	68	50	31	7	1
6	55	26	14	7	2
7	59	36	20	8	2
8	67	42	21	3	1
9	73	48	27	5	1
10	71	41	15	7.5	1
11	71	40	22	5	1
12	75	49	33	10	1
13	77	58	28	12	1

showed that equal parts of fine and coarse gravel gave the best results and this ratio was therefor adopted, since increasing the amount of coarse gravel would cause extra labor, and decreasing the amount of small gravel would involve a loss, either of which would exceed the possible economy in cement.

MOISTURE IN SAND.

It was found that either dry or wet sand packs much more closely than moist sand, the latter having a volume 25 per cent greater than that of the same after complete saturation. In order to attain uniform results, it was only necessary to use saturated sand. Table II shows the effects on the volume of the mix that are caused by the varying amount of moisture in the sand with the standard mix of equal parts of fine and coarse gravel.

Tests 5 and 6 were made with sand taken at random from the bins, and for tests 8, 9 and 10, the amount of moisture in the sand was controlled, although not measured. The size of the sand was such that from 55 to 90 per cent would pass through a screen with an 0.131 opening and from 97 to 99 per cent of it would be rejected by a screen with an 0.0082 opening as indicated by the record of Table III, made with a Universal Sand Tester. These results demonstrated a great variation in the character of the sand, about 13 cubic feet of which were required with the 1:1 proportions of fine and coarse gravel that contained about 9 cubic feet of voids for one batch, and required 4 cubic feet of cement, making a mixture proportion 1:3.25:6.4, mixed with enough water to give the consistency of medium stiff porridge.

The saturation of the sand by giving it as much water as it would hold by capillarity before charging it into the mixer was found decidedly advantageous, insuring uniformity in the charge of sand and aiding the speed and smoothness of the mix. The gravel aggregate was wet with a hose before charging and a measured amount of water was run into the measuring box with each charge of sand. The final adjustment of water in the mix was made by jetting it into the mixer through a nozzle until the desired consistency, as determined by the eye, was reached. The amount of concrete, measured in the forms, averaged about 1.2 yards per batch for the 1-yard mixer.

The work was done under the direction of Arthur E. Morgan, chief engineer, and Charles H. Paul, assistant engineer.

Nile Flood Control Works

Works are contemplated for obtaining such complete control of the waters of the upper Nile as will enable Egypt to develop its agricultural resources to the utmost, secure the country against excessive floods and permit some development of the Sudan's resources. The work will extend over a generation and cost tens of millions of dollars. It will be in charge of a commission consisting of an irrigation engineer, nominated by the government of India, as president; a British physicist, nominated by the University of Cambridge, and an irrigation engineer, nominated by the government of the United States.

Traffic on Iowa Highways

Results obtained by taking actual weights of many thousand vehicles at seven points throughout the state show high tonnage, in which passenger automobiles overwhelmingly predominate, ninety per cent is motor-driven and interstate traffic is insignificant.

With the above title, a pamphlet has been issued by the Engineering Experiment Station of Iowa State College of Agriculture and the Mechanical Arts, the author being T. R. Agg, highway engineer on the station staff. The information it presents was obtained by means of an investigation of the vehicles using Iowa highways.

It was believed that "any satisfactory method of comparing the economy of various types of road surface should take into account the weight of the traffic as one of the factors in the comparison." It did not seem necessary or practicable to weigh all the traffic on all the highways under consideration, but rather to establish adequate categories of weights for the various classes of vehicles and use these in taking future traffic census records.

Traffic weighings were made at seven stations, selected with regard to possible variation in the weight of vehicles in different parts of the state.

All vehicles were arbitrarily divided into the classes: one-horse passenger, one-horse freight, two-horse passenger, two-horse freight, roadsters, touring cars, motor trucks, motorcycles, tractors, bicycles. When the data were finally assembled, however, it was found unnecessary to consider so many classes, since the weights of certain classes overlap to such an extent as to eliminate any real line of demarcation between them. The weights of various classes of horse-drawn passenger vehicles, such as the one-horse and two-horse, overlap to such an extent as to make it undesirable and unnecessary to separate them in computing the weight factor. In the same way, the weights of touring cars and roadsters overlap to such an extent that it is more advantageous to include all passenger automobiles in a single class. The volume of miscellaneous traffic —tractors, riding horses, motorcycles and bicycles —was so small that this class of vehicles was disregarded entirely.

Finally the investigators adopted four groups as representing real differences in class weights, these being horse-drawn passenger vehicles, horse-drawn freight vehicles, passenger automobiles and motor trucks.

At each weighing station, each vehicle passing the station was weighed regardless of how many times that particular vehicle might pass. The weighing was continued for a period of ten days at each station. The method, type of scales used, etc., at these stations were described in Municipal Journal of September 13, 1917. Each driver was asked where he started from and where he was going, and the vehicle was classified thereby in the proper group. It was found possible to handle up to 200 vehicles an hour at a single station without appreciably delaying any of them.

In order to facilitate recording the data, a separate printed slip was used for each vehicle and the desired information merely checked thereon. Each slip contained the names of the several types of vehicle, various tire widths differing by half inches, whether hard rubber or steel, etc. There were also other items for checking, such as chains, empty, grain, coal, wood, produce, in, out, farm traffic, interurban, inter-state, rain, wind, mud, etc.

The mean weights found at the seven stations for pasenger automobiles were: 2,585, 2,520, 2,562, 2,657, 2,801, 2,799, 2,911. The mean weight for all stations was 2,713 and the average weight 2,691. For horse-drawn passenger vehicles the weights vary between 595 and 720, with an average of 671. Horse-drawn freight vehicles varied from 1,780 to 2,282, with the average of 1,998. Motor trucks varied from 2,476 to 5,406, averaging 3,720.

The weight per inch of bearing width of tire was calculated for each vehicle. By far the largest number carried between 150 and 250 pounds per inch width. Dividing the weights into classes varying by 50 pounds, and totaling all stations, it was found that 8,123 vehicles carried a weight of 150 to 200 pounds per inch width, 4,349 vehicles carried 200 to 250 pounds, 1,614 vehicles carried 100 to 150 pounds and 1,005 vehicles carried from 250 to 300 pounds. There was then a pronounced drop, the next highest number being 238 vehicles which carried from 50 to 100 pounds, followed by 147 vehicles carying from 300 to 350 pounds, and 102 vehicles carrying from 350 to 400 pounds; 79 vehicles carried less than 50 pounds and three vehicles carried between 1,050 and 1,450 pounds. Between 400 pounds and 1,100 pounds, the number gradually diminished from 96 to 3.

A study of the various records and averages indicated that a computation of the total tonnage passing over a road, based upon the average weight, would be in error less than 10 per cent (assuming the traffic accounts to be accurate); except that in the case of motor truck traffic there is much wider variation and the error may be considerably greater than 10 per cent. It was believed impracticable to make a traffic count that is exact, but by a proper distribution of counting days to compensate for seasonal and irregular variation, the total annual volume of traffic may be closely approximated.

As the condition of the highways becomes more favorable for the operation of motor trucks and heavy horse-drawn vehicles, the average weight of these classes of vehicles may be expected to increase, and the maximum also to increase unless limited by legislation.

The weight per inch of bearing width of tire for present traffic does not appear to have any direct bearing on design and, if motor truck trailers with steel tires are prohibited, it is not likely that it will become a factor requiring to be considered.

As a result of a large number of measurements of diameter of tire and width of track, it was found that the bearing width of pneumatic tires is very nearly equal to the diameter or "size" of the casing.

The counting was carried on from 7 a. m. to 9 p. m. each day. In a few instances the counting was continued for 24 hours and the data thus obtained, supplemented by special observations, indicate that the traffic actually counted represented 85 per cent of the total traffic for the days of the counting period.

CONCLUSIONS.

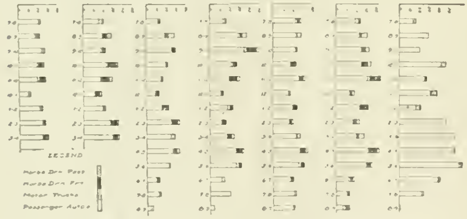
From a study of the census records it was gathered that the tonnage of traffic on Iowa highways is considerably larger than has been generally supposed. "In this state a system of earth roads has been carrying a traffic that would be considered moderately heavy for a paved road."

Passenger automobiles overwhelmingly predominate at present. The present highways, because of the extreme variations in the condition of the surface, do not encourage the use of motor trucks. The development of truck hauling, particularly for farm products, apparently has been held in abeyance pending the construction of suitable road surfaces.

The insignificant amount of interstate traffic at all of the stations, except near the state line, ought to set at rest the idea that highways are being constructed primarily for the use of tourists. The very considerable amount of interurban traffic is an indication of the extent to which the motor car is utilized for travel by town people.

About 90 per cent of the tonnage of traffic on Iowa highways is motor-driven, which emphasizes the equity of requiring a substantial contribution from owners of motor vehicles toward the construction and maintenance of public highways.

The pamphlet gives the estimated annual tonnage of the various kinds of vehicles in each of the counties of the state. The annual tonnage on the highways of the several counties was estimated to vary from 11,379 to 579,539.



TOTAL NUMBER OF VEHICLES PASSING PER HOUR FOR EACH OF SEVEN DAYS AT STATION 108.

That there was considerable hourly variation in the number of teams, and that this variation differs on different days, is illustrated by diagrams presented with the report, one of which is reproduced herewith.

The Western North Carolina Weekly Press Association at a recent meeting endorsed the program for a system of hard-surface roads in that state. They called upon the Governor and Assembly to provide the ways and means for their construction and urged that the funds be distributed impartially to the several counties of North Carolina.

Baltimore County Highway Work

Work last year on nine hundred miles cost nearly half a million dollars. Considerable machinery was used. Most of the work was of the nature of maintenance.

During the year 1919 Baltimore County, Md., spent $492,417 on its roads, work having been done on 902.4 miles of highways. In the annual report of William G. Sutro, Baltimore county roads engineer, the expenditures are given in condensed form for the entire county, and in addition, a more detailed statement is given for each district. From this report the following items of information are gleaned:

The total expenditure by all of the counties for labor was $81,261, while for material there was spent $383,361, and $27,795 miscellaneous expenditures. These figures indicate that only about 1/6 of the total expenditures was for labor. This, we believe, is a somewhat unusual ratio. Part, at least, of the explanation for it may be found in the amount of road machinery owned by the county. This machinery included 16 road rollers, three crushers, 5 tractors, 6 concrete mixers, 17 road scrapers, 2 scarifiers, 12 water sprinklers, 17 tar kettles, 12 gas pumps and 1 hand pump, 8 motor trucks and one touring car.

Of the rollers, 3 are Monarchs, 4 Buffalo-Pitts, 6 are Kelley, 1 Giser and 1 Russell. The 16th is a gasoline roller, make not given. Of the crushers, 2 are Holland and 1 Climax. Of the tractors, 3 are Fordson, 1 International and 1 Huber. The concrete mixers are all of 5 cubic feet capacity, make not given. Of the road scrapers, 2 are Climax, the names of the others are not given. Of the motor trucks, 2 are International, 2 are Autocar oilers, one is a Nash Quad, 2 are service trucks, make not given, and the touring car is a Chevrolet.

Most of the work was in the nature of ordinary maintenance. The report of District No. 1 may be considered as fairly typical of all the others. In this district approximately 50 miles of ditches were opened and a number of wooden bridges repaired and put in safe condition for travel. Four wooden bridges were replaced by reinforced concrete. Approximately 10 miles of road was resurfaced. A number of roads and avenues were given surface treatment of oil and gravel. One wooden bridge was replaced by a 36-foot corrugated iron pipe. Altogether, 170 feet of corrugated iron was used in the district for culverts. In patching pot-holes there was used 5,036 gallons of patch material.

The replacing of wooden culverts and small bridges with corrugated iron pipe appears to have been quite general, only 2 of the 15 districts failing to report the use of more or less of such pipe for this purpose. Several of them also report the construction of concrete bridges to replace old wooden ones. Altogether, 35 concrete bridges were built in the county last year at a total cost of $21,690; these including a considerable proportion of small spans which would be classed as culverts. This brings the total number of such bridges and culverts in the county up to 553.

Highway Work in Giles County, Tenn.

Information furnished us by the resident engineer for Giles County of the Tennessee State Highway Department indicates that there are certain features connected with highway work in some of the older states that fortunately are not found in most of the newer ones. For instance, old toll roads continue in service in this county; 16 miles of such roads were bought by the county last year but about 29 more of these privately owned roads remain.

Another relic of older methods is the working out of taxes. The county included in its report of expenditures for last year $100,000 as the estimated value of taxes "worked out." It is encouraging to note that the County Highway Commission expects to buy two complete road equipments, and it is to be hoped that these will not be enrusted to those who are working out taxes but will be operated by a regular force. We have yet to learn of a county, township or other political unit which has obtained, from this working out of taxes, results satisfactory to any one except those who thus avoided paying out real money by doing a little half-hearted, unintelligent, and often worse than useless, work on the roads in their vicinity.

Constructing a Concrete Road in Nebraska[*]

By A. S. Mirick[†]

Round, water-worn gravel of feldspar and quartz, the only material available in the state, was tested for use as the concrete aggregate, making stronger concrete than Potomac River gravel, and is now being used for six miles of the Lincoln Highway.

Nature has been niggardly to Nebraska in the matter of bestowing materials for hard-surface roads. The stone supply is confined to the southeastern portion of the state, and consists of limestone deposits of varying hardness. Some samples show a French coefficient of wear of eight, but the hard strata are so distributed in the quarries that it is almost impossible to get a uniform product that would be suitable for an aggregate for concrete pavement.

The Platte river runs through the central part of the state, and for ages it has been rolling down the feldspar and quartz rock from the Rockies and depositing the same in Nebraska; so that in many places this material is pumped up, screened and graded, and makes splendid aggregate for concrete. The material in question, however, violates a favorite condition that engineers have made a part of their fine aggregate specifications, viz.; that the particles must be sharp. This theory has been proven fallacious, for the rounded particles, if they are clean and hard, have been found to develop more strength than the sharp variety.

The material pumped up from the Platte river has another characteristic that has caused engineers to be cautious, that is its fineness. One who is familiar with Prof. Abrams' tests, knows that he has developed a theory that if a material shows a certain modulus of fineness, depending upon its grading, this material may be composed of any sized aggregate. Even the grading is relatively unimportant in comparison with water content. With this theory in mind, it was decided to send a sample of the Platte river material to the testing laboratory of the Bureau of Roads, Department of Agriculture, Washington, to determine whether so called Platte river gravel would meet with their approval for use on concrete paving work in Nebraska. This matter was an important one as it meant utilizing the greatest supply the state has for paved road. The analysis of the sand-gravel mixture was as follows:

Passing ¾" mesh screen and retained ½" screen..	2.0
" ½" screen and retained ¼" screen........	12.7
" ¼" screen and retained ⅛" screen........	85.5

Retained on ¼" screen....................Per cent.	14.7
Passing ¼" mesh retained on 10 mesh...........	44.4
Passing 10 " " " 20 "	27.9
Passing 20 " " " 30 "	5.5
Passing 30 " " " 40 "	3.1
Passing 40 " " " 50 "	1.3
Passing 50 " " " 80 "	1.9
Passing 80 " " " 100 "	0.2
Passing 100 " " " 200 "	0.5
Passing 200 "	0.5
	100.0

Loss by washing silt and clay........................	0.4

The sample consisted essentially of rounded fragments of granite, quartz quartzite, with a large amount of subangular quartz sand.

Samples of the material were tested for compression and compared with Potomac river screened gravel. The mixture of the Platte river sand-gravel was one part of cement by volume to three parts of the sand-gravel.

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[*] From The Cornell Civil Engineer, slightly condensed.

[†] Chief construction engineer, Nebraska Department of Public Works.

The Potomac river material was used in proportion 1 part of cement, 1½ part of Potomac river sand, and three parts of Potomac river gravel measured by volume. The dividing line between sand and gravel, of course, being ¼" mesh screen; all that was retained on this screen was considered gravel, and all passing through considered sand.

6" x 12" cylinders were prepared of concrete made from both materials and aged 7 days. Two test samples were prepared of each. The total loads sustained by the clinders of Platte river gravel were 58,350 lbs. and 65,940 lbs. with an average of 62,145 lbs.

The total loads sustained by the cylinders of the Potomac river gravel were 57,780 lbs. and 58,180 lbs. with an average of 57,980 lbs.

The average unit crushing strength of the Platte river sand-gravel concrete was 2,198 lb. per sq. in. The average unit crushing strength of the Potomac river gravel concrete was 2,050 lb. per sq. in.

As a result of this test it was decided to use this material for paving with concrete a portion of the Lincoln Highway 5.94 miles in length running from Fremont to Ames.

SECURING AND HANDLING AGGREGATE.

The plans for this stretch of concrete paving called for a pavement 18 feet wide, the thickness in the center being 8 inches and the thickness on the sides 6 inches, the pavement being laid in blocks 36 feet long with a ½ inch elastic expansion joint separating each block from its neighbor.

The Platte river runs parallel to this road and material for the aggregate could be obtained with very easy hauls direct from the plants operating along the river in the immediate vicinity of the road. Consequently the contract was let for the construction of the road at a cost of $199,440.34.

The gravel is dredged from the shores of the Platte river. The effluent from the pump carries the sand and gravel to a series of sorting screens and chutes, where the fine and waste materials are returned to the lake pit. The material to be used is delivered into the bins ready for truck loading. The material is then hauled to piles located at convenient places along the road for storage. The hauling from the bins to the stock pile is done by trucks.

Near these stock piles a platform for storing cement bags has been erected, and all of the charges for the mixer are carried from the stock piles by means of Ford trucks. These Ford trucks are equipped with Lee dump bodies holding 21 cu. ft. of sand-gravel mixture The sand-gravel mixture is loaded on the trucks by means of an automatic loader. This charge is rushed to the mixer, dumped, and the truck returns at a 50 miles an hour gait for another load. The advantages of this manner of handling material from the stock piles to the mixer over the old method of hauling by teams are as follows:

1. The sub-grade is kept in good condition ahead of the concrete by the action of the over-sized tires of the Fords.

2. The speed of operation of the trucks obviates the confusion and congestion that occur with teams, since many teams must be on the road to handle the same amount of material.

3. It eliminates the old time skinner, who sleepily dozed over a pair of mules, and utilizes the young man who has a real interest in motor vehicles, encouraging him to work at something he really likes and helping to solve the labor question.

4. Above all, it greatly diminishes the number of men required, and entirely eliminates the difficulties of using teams.

LAYING THE CONCRETE.

The concrete is mixed in a large three-fourths yard Foote concrete mixer. This mixer is equipped with caterpillar tractors that distribute the load of the mixer on the subgrade at a pressure of about 4½ pounds per square inch. The ease with which this machine can be moved forward with little damage to subgrade makes it an ideal machine for concrete paving.

The forms used are Blaw-Knox pressed steel forms that combine the qualities of a form with a track to receive the Lakewood finishing machine which was used.

As soon as the concrete has set, if the temperature is high, the pavement is covered by a tarpaulin. This is removed after a short period and a covering of not less than two inches of earth is applied and kept moist for a period of at least ten days.

Sieve analyses are made of the sand-gravel aggregate from time to time. Very close watch is kept on the material to see that it conforms exactly with the specifications. Very little variation of the coarser material is allowed and any deficiency in this respect has to be adjusted.

This work is supervised by the Department of Public Works of the state of Nebraska aided by the government. The state places a project engineer on the work, who is supplied with such assistants as he needs. He is required to lay out the work, secure samples of material, and to be responsible for the inspection of the same. He makes a daily report to the department of material used and progress made. His work is also subject to inspection from time to time by the officials of the state and Department of Agriculture. He makes all measurements for estimates, and certifies the same.

This work, though it represents a small part of Nebraska's road building program, is being watched by engineers in the middle west with a great deal of interest, for on the result of this work may rest the solution of the problem of cheaper pavements for some of the central-western states that have no suitable material for coarse and fine aggregate. The successful use of the Platte river deposit will have a great influence in extending hard surface road systems in Nebraska and adjoining regions.

The great irrigation pump installed by the Glenn-Colusa Irrigation District is believed to be among the largest in the Western states. The discharge pipe of the pump is ten feet in diameter and throws 375 cubic feet per second. The pump is the seventh, and largest, to be installed at the head of the system to take water from the Sacramento river.

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Highways and Unprogressive Counties

In tabulating the data received by us during the past month or two, concerning county highway work, our attention was attracted by the very large number of new counties reported, especially in some of the Western states, where fully 50 per cent of those now existing have been created during the past four or five years. With the creation of new counties there naturally arise problems in connection with organizing officials and forces for county work, the chief of which in most cases is highway work.

As an illustration, the county engineer of one of the new Idaho counties informs us that that county was created by a bill passed in March, 1919, separating it from another county, the chief reason for the separation being the miserable condition in which the original county permitted its highways to continue. Says our informant: "None of our taxes were expended judiciously before we were made a new county and we are just getting ready to cooperate with the State and Federal aid" on the construction of some of the principal routes in the county. The chief of these routes is 45 miles long and 14 miles has already been surveyed and plans and specifications prepared. Also the new county expects to hard-surface this season approximately six miles of another route, twenty miles of which has been surveyed. Outside of this hard surfacing, the county expects to build twenty miles of dirt road and rebuild six wooden bridges, two steel bridges, two concrete bridges and eighteen culverts of corrugated steel.

This is quite an ambitious program for a county only 12 months old, and apparently justifies the withdrawing of it from the old county under which no road work was carried on. It is quite possible that a number of other subdivisions into new counties were occasioned by similar dissatisfaction with unprogressive elements in portions of the old counties; in fact, we have been informed that this was the case in a number of such instances.

The question suggest itself, what will be the effect of this subdivision upon the unprogressive sections, which are thus left alone in their unprogressiveness? Also, should one of these unprogressive counties lie across the route of a proposed interstate or transcontinental highway, how would it be possible to secure the improving of such section of the highway? Does not this furnish an argument for nationalizing the more important highways in order to prevent this occasional break in long, continuous routes which, throughout the rest of their course, are kept in the best of condition for both pleasure and commercial traffic?

More Equitable Construction Contracts

The general contractor usually spends so much time and money in making ten costly estimates for every contract that is awarded him, and then is so intent on making a living profit, or in coming out whole on the job, that he has accepted the condition of almost universally permitting the owner's attorney to write the contract and the owner's engineer to write the specifications. These contracts and specifications hold the contractor to the most rigid execution of an agreement which is often arbitrary and is invariably drawn to give the major advantage to the owner and generally to throw all risks and responsibility on the contractor, leaving him little to gain and much to lose by almost any unforeseen contingency, change or delay.

There are few competent judges who have studied the situation but have, for many years, strongly urged the adoption of a more equitable and considerate treatment for the contractor and less drastic and one-sided covenants which the contractor is practically compelled to sign in order to have any opportunity of doing work.

Government and municipal owners have been the worst offenders, in that their power is usually greater, that their officers in charge of the work usually have little discretionary power or dare not use it if they have, and that, in case of litigation, their legal resources and privileges are much greater than that of the average contractor.

In attempting to ameliorate this condition, a special committee of the Associated General Contractors of America has studied more than 100 different forms of contracts and has formulated modifications and additions calculated to secure high-class work at a reasonable cost, protect the interest of the owner and at the same time safeguard the contractor against some of the more common injuries and unnecessary risks to which he is often subjected without compensation.

The proposed contract provisions, which are reprinted on page 499, have to do chiefly with the elements of time, market fluctuations, conditions over which contractors have no control, surety bonds, payment, changed quantities and arbitration. Under all of these heads, there have been many notable cases in which the contractors have suffered unjustly and often very seriously. There are few if any cases on record in which the owners have suffered directly from the same causes.

The recommendations are evidently made with the spirit of fairness and, in most cases, tend to improved conditions and to evenhanded justice for both parties. Some of these clauses are already substantially incorporated in existing contracts and others probably will be easily made acceptable to owners. Among those seldom found at present are the proposed limitation of retained percentage, the systematic proportionate reduction of the surety bond as the work progresses, the sliding scale for unit prices when quantities are changed, and arbitration as last appeal for interpretations and decisions.

Of these the last two are probably the most important and perhaps the most difficult to make acceptable to owners. They are absolutely just and should be vigorously maintained because, without jeopardizing the owner, they protect the contractor against conditions that very many times have caused him serious loss and sometimes complete ruin.

The clauses providing for a modification of the contract bid and a sliding scale of prices to offset changes in the market prices of labor and material and freight are sound in principle, but should not be applied too far; that is, a certain amount of risk from such changes should properly be assumed by the contractor, but when the changes are great enough to involve more than a reasonable percentage of his justifiable profit, they should be covered by some such arrangement as is proposed.

The list does not mention a very important provision which should be made, to the effect that in any contract the execution of which necessarily conflicts with any federal, state or municipal laws or requirements or in which the proper execution of the contract involves unavoidable property damages, the owner should assume responsibility, and that the owner should also assume responsibility for the direct results of the contractor's compliance with the engineer's orders to do or refrain from doing certain things.

The Most Hazardous Industry

An analysis of the income tax returns made by a committee of experts shows that for each dollar of profit made by construction corporations, the loss is eight times as large as it is in manufacture or agriculture, five times as great as for transportation and public utility corporations, and three times as great as for mining, which is often considered as little better than gambling.

To a considerable extent this risk is unavoidable because the engineering contractor almost invariably covenants in advance, sometimes several years in advance, to perform difficult and important work for a previously fixed amount, usually not greatly in excess of a careful estimate of the exact cost, and under conditions that range from totally unknown quantities and price costs to well-known quantities that may suffer considerable arbitrary change.

Often many vital conditions are entirely unknown and can be disclosed only by the progress of the work, and nearly always, especially of late years, there is possibility if not strong probability of great increase in the cost of labor and materials that form a very large part of the total costs.

The work is often imperiled by hazards such as floods, fire and political, financial and industrial disturbances which the contractor can neither foresee nor safeguard himself against. In addition, most important contracts are subject to more or less change of design and delay in execution, both of which, in nearly all cases, cause serious loss to the contractor. The contractor is subject to great depreciation of plant, high overhead and numerous extraordinary expenses, some of which easily escape due recognition in the estimate and bid.

Inexperienced contractors almost invariably fail to make sufficient allowance for these risks, and this makes the total losses greater and the difficulties harder for the competent contractor, for, although the first time that the inexperienced ones fall into serious difficulties they are likely to go bankrupt, new ones constantly appear with unduly low bids which seriously injure the conservative contractors.

There are only two remedies and they but partially eliminate the danger; first, no inexperienced contractor should undertake an unfamiliar, complicated or hazardous work or any work not showing proper allowance for overhead, for contingencies, for all fixed charges, for personal salary and for a reasonable profit allowing for a margin of delays and market fluctuations in items that cannot be provided for by preliminary engagement.

The other remedy lies in the very material modification of the terms of the contracts ordinarily accepted by contractors. Many of them are entirely unfair to the contractor, placing all the risk and responsibility on him and allowing him no corresponding opportunity for extra gain, even if he is foolish enough to gamble on the chances. Some contracts, and unfortunately those used by some powerful municipalities, are notoriously unjust to the contractor, who may have small chance of coming out even unless he can find some way to secure extras, allowances, or even to get away with inferior workmanship or materials or deficient quantities. Other contracts are so vague and indeterminate that they really depend entirely on the arbitrary decisions of the engineer and inspector who can, and sometimes do, absolutely ruin a contractor by their decisions. In these cases, the contractor should absolutely refuse to bid until the contracts are made just and fair, the objectionable clauses are eliminated, and safeguards are inserted.

Forest Products Engineers Wanted

The United States Civil Service Commission announces examinations for an engineer in forest products at a salary of $2,160 to $3,600, and an assistant engineer in forest products at a salary of $1,500 to $2,100. The positions are open to all citizens of the United States, both men and women. The duties will be to plan investigative tests dealing with the physical and mechanical properties of wood, processes of preserving wood, practical problems of the pulp and paper industry, wood distillation, naval stores industry, or other problems involved in the utilization of wood; to make or supervise the making of such tests, compile analyses, prepare reports, and present the results of researches to either the public or private individuals.

Competitors will be rated on their education and experience, upon their own sworn statements made in their applications and upon corroborative evidence, there being no examination given. No age limit is set. Applications must be filed with the Civil Service Commission at Washington by June 22. Futher information can be obtained from the commission.

Disposal of Municipal Wastes

By Joseph Goder

Continued from page 474 of the previous issue. In this instalment the author discusses the reclamation of the fuel value of the different kinds of waste.

RECLAMATION OF FUEL VALUE OF WASTE.

This method of refuse disposal is so important and far reaching, and at the same time so little appreciated in this country, that we feel compelled to deal with it more explicitly.

It is universally conceded that the conversion of refuse into heat or the destruction of refuse by fire is the most desirable method from a sanitary point of view. Frequently grave objections are raised in regard to the economic side of this process. However, these objections hold true in very few instances, and if the disposal problem as a whole is considered, close investigation will reveal also the financial advantage of this method.

The reasons for this misapprehension are the fact that the crematories generally used are absolutely inadequate for the proper combustion of city refuse, and the superficial improper design of the entire disposal system.

All waste matter contains a certain amount of fuel value which can be utilized to aid its disposal and may be converted into heat units and commercially exploited.

We have already called attention to the necessity of determining the thermal value of each kind of refuse. It may be opportune to give a few more pointers in this regard. Following the classification previously given, sewage, or rather the solids contained in sewage, may be reviewed first.

The most widely used sewage treatment is the separation of all or at least the major part of the solids of sludges. Various methods are employed to effect this separation. It is outside of the scope of this article to dwell on the different methods and we only mention a few facts to be considered in connection with the final disposal of the sludge by incineration.

Some of the processes employed have a direct effect on the calorific value of the sludge. In deciding on the method to be employed, this important fact is often overlooked. The disposal, or rather utilization, of the sludge is a more vexing problem than the sludge separation or the production of a satisfactory effluent. Sludge subjected to biological treatment—from Imhoff tanks or otherwise—contains a lower heat value than untreated sludge, the action of the micro-organisms having reduced the organic constituents, while the mineral and unorganic matters are only slightly affected This is one reason why in some instances experiments to incinerate sludge have failed, notwithstanding a reduction of the moisture content effected by a secondary treatment. The composition of sludge varies according to local conditions affecting their heat value. We have reports of sludge containing as much as 15,000 B. t. u. and more (Kershaw reports sludge from the city of Dortmund to contain as high as 17,120 B. t. u. dry). An average fuel value of 7,500 B. t. u. may be safely assumed. This value is sufficient to permit at least auto-combustion of sludge containing from 50% to 60% of moisture, provided suitable furnaces are employed. Sludge drawn from the settling tanks contain from 88% to 95% moisture. This moisture content must be reduced if the sludge is to be disposed of by any practicable method. From a pure technical viewpoint this is easily done; however, economic and aesthetic considerations are more difficult to overcome. Reduction of the moisture content by mechanical means (pressing, centrifugalizing) involves considerable expense. Utilizing natural heat and air in sludge beds is confronted by aesthetic and hygienic obstacles. It appears to the writer that the most logical plan to follow is to use the contained properties of the sludge to overcome the obstacles or to effect its own drying disposal. This is satisfactorily accomplished abroad. The failures experienced with the conversion of sludge through its own fuel value are solely due to the faulty design of the means (primarily the faulty design of the incinerators or producers).

Night soil hardly enters into consideration as a class of refuse to be separately treated. In most communities having a sanitary sewer system this material forms a part of the sewage. Communities not equipped with sanitary sewers are as a rule of a rural character. The utilization of this valuable fertilizer in its natural state offers no serious obstacles. Its fertilizing value certainly outweighs manyfold the harmless inconvenience produced by its effluvia. The humification and mineralization of the faeces and other ingredients progress rapidly, especially as the distribution of this matter assures a thorough aeration, and absorption of oxygen. Sporadic local conditions, epidemics or pathogenic excreta from hospitals call for other disposal means. In such cases evaporation and incineration are the proper procedures.

The caorific value of garbage is frequently underestimated. Most garbage contains sufficient heat value to effect its own incineration under favorable conditions. With an average moisture of 70%, the average city garbage possesses 1,500 B. t. u. per pound as collected. Rubbish and ashes as collected can safely be estimated to produce 5,000 B. t. u. per pound. The sorting of salable material will not greatly affect the heat value of rubbish. It merely reduces the quantity of rubbish to be incinerated. The calorific value of ashes is sufficient to warrant its reclamation in many cases. Street sweepings and stable manure contain likewise a fuel value in excess of 2,000 B. t. u.

As afore mentioned, one of the prime advantages of utilizing the heat value of city refuse is the general adaptability of this method. Thus, not only the entire collection and disposal system is greatly simplified, but also its reliability is enhanced. We have mentioned this fact previously in connection with the discussion of other disposal means. A well designed forced-draft refuse furnace or incinerator should produce from the average mixed city waste at least one pound of steam per pound of refuse above the steam required for the forced draft. Utilization of this steam power can be found in most cases. Sewage disposal plants, garbage reduction plants, water works, etc., offer a ready outlet for the excess power. Electric current can be generated to light public buildings. A city yard, stables and repair shop form an ideal location for a refuse disposal plant.

The clinkers from a forced draft incinerator plant are a valuable by-product generally not taken into consideration. These clinkers are a most desirable material for biological filterbeds and demand high prices. For concrete and road work they are of considerable value.

A point to be considered is the location of the disposal plants. A modern incinerator plant is absolutely free of any nuisance from smell or soot, and may be centrally located, an advantage not possessed by any other process. A division of the entire disposal system into different plants properly distributed reduces the collection cost. Large units increase the cost of hauling. We would, however, recommend, in order to utilize the heat value economically, to provide for units not smaller than 50 tons daily capacity (preferably 75 to 150 tons). However, local conditions and consideration of utilization of the heat value largely govern this decision.

As mentioned before, the faulty design of most refuse furnaces is to blame for the antagonism against incineration. A few of the characteristics a successful refuse furnace must possess are here inserted.

High furnace temperatures are a condition of cardinal importance. High furnace temperatures can be maintained only by a forced draft, allowing reduction of excess air to a minimum and producing a high ratio of combustion. All heat-absorbing surfaces in the furnace chamber shall be eliminated. Combustion room temperature shall average at least 1,500° F. and at no time during operation shall it drop below 1,000° F. Furnace gases on their way to the combustion chamber shall not travel over wet material, so as not to reduce their temperature below the ignition point. Large combustion space must permit full expansion of the gases. Waste heat should be recuperated and utilized to preheat air for combustion. All incombustible matter should be molten homogeneous clinkers. Sifting of incompletely combusted particles into the ashpit should be eliminated. Furnace shall be fed in small charges, so as not to reduce furnace temperatures temporarily. Refuse shall be fed into the furnace in a way not offensive or injurious to the health of the operators.

All these conditions must and can be maintained in a properly designed incinerator plant. They have been complied with in all modern installations abroad and there is no reason why we should be satisfied with inferior design, handicapping the successful solution of our disposal problems. Claims that conditions in our country vary widely from conditions met abroad and that different furnaces could be used can not be sustained, as every one familiar with the problem knows, and these claims are disproved by existing installations.

Hetch-Hetchy Bond Litigation

As recently noted in Public Works, an important contract has just been awarded by the city of San Francisco to the Construction Company of North America for driving an 18-mile aqueduct tunnel through the Sierra-Nevada Mountains for the new Hetch-Hetchy Water Supply. There has been considerable opposition to the work and much difficulty has been encountered in financing it because the city wishes to pay for it with bonds which are not saleable at par and which its charter prohibits it from selling below par.

The contract was finally awarded on the cost-plus-fee basis and a suit has already been instituted for an injunction to prevent the city from making the initial payment of $276,000 on the contract. Another suit has been filed against the treasurer of the Construction Company, whose attorney states that the work will not be halted by the injunction, and that the Construction Company itself will immediately buy from the city at par and accrued interest, $571,000 worth of Hetch-Hetchy bonds. The Construction Company has volunteered to place $600,000 cash in the city treasury to give it working funds for the next two months and to wait for the contractor's fee until the legal difficulties are untangled.

Plans have been very carefully prepared for an exceedingly valuable water supply and hydro-electric power plant for the city and considerable preliminary work and money have already been expended on them. In comparison with other similar projects, it does not appear that this is either ill-considered or unduly costly, and as it is urgently needed and the costs have been rapidly increasing and are likely to go still higher with further delay, the work should be promptly executed and no malicious or artificial obstacles placed in its way. The officials in charge are entitled to great credit for their courage and ability in carrying the project so far along through the recent difficult times and should be aided to the utmost rather than hindered.

Water Filtration for Detroit

The city council of Detroit has authorized the issuing of twelve million dollars of public utility bonds, subject to approval by 60 per cent of the voters at the August election. The object of this bond issue is the construction of a filtration plant. Experiments have been under way for two years with a view to determining the details of filtration most suitable to local conditions and plans for the plant have been prepared. (See Municipal Journal & Public Works for May 10, 1919.) Machinery has been purchased and the contract let for a low lift pumping station which will increase the capacity of the present pumping station and later will form a unit of the new filtration plant. If these funds are voted, it is hoped to be able to furnish purified water in about four years. The proposed plant is calculated to supply 300 million gallons per day, although there is anticipated an average consumption of only about 200 million gallons by 1930. The plant will therefore provide for a temporary increase of fifty per cent over the average for six years after its completion.

Contract Provisions Proposed by Contractors

Report of a committee of the Associated General Contractors recommends the incorporation in all contracts of several provisions dealing with fluctuating costs, partial payments, stopping work, bonds, penalties, inspection, extra work, arbitration, and other points.

The Committee on Contracts of the Associated General Contractors of America during the past year has made a study of 113 different forms of contracts of various types. As a result of this study the committee approves certain provisions, and recommends that they be included in every contract made by members of the association.

Commenting upon the general subject of contracts, the committee states that "an analysis of income tax returns shows that contracting is the most hazardous industry in the country," the loss for each dollar of profit made by construction corporations being eight times as great as it is in manufacture, agriculture, or personal service corporations; five times as great as in transportation and public utility corporation; over three times as great as in mining and quarrying, and nearly twice as great as in banking. It argues that the more such uncertainties can be eliminated, the lower will be the costs of construction to the owner, the more satisfactory will be the relations of the architect or engineer with the contractor, and the more will contracts be awarded on a basis of skill, integrity and responsibility.

"From the very nature of construction, many of these uncertainties can never be eliminated. They must be assumed by either the contractor or the owner. Some which are now assumed by the contractor ought by right to be assumed by the owner. Other uncertainties may be eliminated entirely to the advantage of both parties. The improvement of present contract provisions is one of the simplest solutions for this problem."

The provisions proposed to secure the results referred to are given as follows in the report of the committee:

Proposed Contract Provisions

1. *Action on Bids.*—Bids should be submitted with the provision that they must be acted upon within a reasonable time.

2. *Freight Rate Changes.*—Bids should be submitted on the basis of existing freight rates, with the provision that in case a change in rates should occur between the time bids are received and the date fixed for the completion of the contract, the contract price should be increased or decreased accordingly.

3. *Wage Scale Changes.*—Bids should be stated and be submitted on existing wage rates, with the provision that the contract price shall be increased or decreased in accordance with any change in such rates before the date fixed for the completion of the contract.

4. *Material Price Changes.*—Bids should be submitted on the basis of existing prices for materials f. o. b. the producer's plant or distributor's yard, with the provision that the contract price shall be increased or decreased in accordance with any change in such price that takes place within the time allowed the contractor to purchase and fabricate his materials.

5. *Monthly Estimates.*—Monthly estimates should include materials delivered and suitably stored as well as materials incorporated in the work.

6. *Partial Payments.*—Certificates should be prepared and delivered to the contractor between the first and tenth day of each month, showing the proportionate part of the contract price earned during the preceding month. These certificates should be paid by the owner by the tenth day of the month. Interest on deferred payments should be paid the contractor at the prevailing rate.

7. *Contractor's Right to Stop Work.*—Under the following conditions the contractor should have the right to stop work or terminate the contract upon three days' written notice to the owner and the architect, and recover from the owner payment for all work executed and any loss sustained upon any plant or material and reasonable profit and damages:

(a) If the work should be stopped under an order of any court, or other public authority, for a period of three months, through no act or fault of the contractor or any one employed by him;

(b) If the architect or engineer should fail to issue the monthly certificate for payment in accordance with the terms of contract;

(c) If the owner should fail to pay the contractor, within seven days of its maturity and presentation, any sum certified by the architect or engineer or awarded by arbitration;

(d) If the owner does not permit the contractor to proceed with construction within a reasonable time after signing the contract.

8. *Retained Percentage.*—The retained percentage should be based on 100 per cent of the work performed and should never exceed 10 per cent. When the amount retained reaches a total sum, which shall be mutually agreed upon by the owner and the contractor, no further reduction from payments should be made.

9. *Surety Bond.*—Where a surety bond is given, it should be reduced at agreed intervals so as to cover thereafter only that portion of work then uncompleted.

10. *Penalty Clauses.*—Wherever any provision is incorporated in the contract for a penalty against the contractor (including liquidated damages), there should also be inserted a provision for a bonus of like amount.

11. *Acts of God or Public Enemy.*—The contractor should not be held liable for results arising from the acts of God or a public enemy.

12. *Time Allowed for Completion of Work.*—The time allowed for the completion of the work should be based on "weather working days" instead of on elapsed time, and, if necessary, allowance should be made for time spent in performing unproductive work made necessary by floods or other natural causes beyond the control of the contractor.

13. *Inspection.*—Where practicable, materials should be inspected at the source so that costly delay may not result from the rejection, at the site of the work, of materials furnished in good faith by the contractor.

14. *Force Account Work.*—Payment for force account work should be made on the basis of the total actual costs of the work, including the actual labor and material costs, rental on equipment, liability insurance, etc., plus a reasonable percentage to cover overhead and profit, total to be not less than 15 per cent.

15. *Change in Quantities.*—In case the actual quantities of any item in a unit price contract are less than the estimated quantities by more than a certain fixed per cent, the unit price paid the contractor for that item should be increased by an amount to be agreed upon. Similarly, a decrease in the unit prices should be made in case the quantities are increased over the estimate by more than a certain fixed per cent.

16. *Arbitration.*—In no case should the engineer or architect be made the final judge as to the interpretation of the drawings and specifications or the performance of the contract. All decisions and interpretations should be subject to prompt arbitration at the choice of either party to the dispute.

Foreign Attitude Towards Emigration

It is reported from Washington that more than 600,000 persons from most of the European countries except Germany, Austria, Hungary, Russia and Turkey have applied for permission to enter the United States. In some countries, emigration is discouraged if not prohibited, and difficulty and delay are experienced in securing passports permitting emigrants to leave, besides which there are trouble, expense and formality in securing permission to enter this country. The matter should be simplified and so arranged as to be completely conducted at the frontiers of the foreign countries.

All officials should admit and welcome all honest, industrious, law-respecting workers who are willing to come to this country for the sake of making themselves homes and becoming loyal citizens. Those that are incompetent, vicious, doubtful, or that have radical political opinions, should be rigidly excluded by investigations conducted on the other side. Good health and decency should be the principal assets required and money and literacy requirements should be relaxed at present.

The opposition of foreign governments can retard but cannot wholly prevent immigration to America. The difficulty that must be anticipated and safeguarded against is that indicated by the reported statement of a member of the Italian Chamber of Deputies who is reported to have said: "Emigration is again our safety valve. The police would like to sweep out these people as soon as possible." It has further been stated that foreign officials issued certificates of good character to applicants whose previous criminal records had already debarred them from acceptance by the United States officials.

Such conditions should, of course, be carefully investigated. They are probably very much in the minority and most of the emigrants can be made acceptable and valuable. A Congressional committee is now investigating the procedure for examining and rejecting or accepting immigrants in their home countries. Properly carried out, this should afford a satisfactory alternative to the exclusive measures demanded by labor leaders and the unrestricted welcome that some industrial interests would extent.

Immigrants Steadily Arriving

According to the Ellis Island records, thirteen steamships, bringing from 104 to 1,900 immigrants each, landed a total of 8,912 at Ellis Island during the week ending May 22. Assuming that this is about 80 per cent of the total number of aliens arriving at all ports of the country, it would mean about 11,000, a slight falling off from some previous weeks, but still a sufficient number to show the positive influx of labor that is so much needed.

It should be remembered that facilities for passenger transportation from Europe have been tremendously decreased since before the war so that difficulty is encountered by the foreigners in securing passage and it probably taxed most of the available space in the thirteen ships mentioned to bring out the number that they did bring. Few of these ships were large as compared with some of the great liners, like for instance the Cleveland, the Pennsylvania and others, which in former days would bring more than 2,400 in their steerage, but are no longer available, not less than twenty-five of these boats, with a combined capacity of 40,000 passengers for each trip, having been subtracted from this before-the-war list. If they were still plying between European and United States ports, the number of immigrants would doubtless be much greater and would probably increase more and more rapidly notwithstanding the passport restrictions which delay and obstruct their arrival.

The quite natural policy of the foreign nations to send us their undesirables and keep their industrious labor at home is diametrically opposed to what should be our policy. We, perhaps, cannot be quite as strict in the entrance requirements as we would be if our need for labor was less, but with moderate restrictions intelligently carried out, there is no doubt that many desirable immigrants, fleeing from severe conditions abroad, will come to our shores in increasing numbers, and, if properly treated, Americanized, and distributed, would gradually relieve the labor famine which is a very real menace to our prosperity.

We should remember that Europeans are not the only aliens that can help do our work. Chinese, Mexicans, West Indians and others are available and under proper restrictions and regulations should be admitted despite the protests of the labor unions.

Advices from Chicago state that the manufacturers there report an improved mental attitude of laborers reducing the turnover and showing for the first time in many months a slight improvement in general labor conditions.

Admitting Chinese Laborers

Writing a few days ago, John Ericson, whose letter suggesting the importing of Chinese laborers was published in our issue of May 15, informed us that he had heard from more than one thousand engineers, located in every state of the union, and that, of these, 61 per cent favored importation of Chinese labor, 7½ per cent favored importation of some labor, 8½ per cent favored other immigration, 10 per cent were against any immigration, 9½ per cent were neutral, 1 per cent advocated wider use of labor-saving machinery, and 2½ per cent were awaiting further information.

A number of those who favor the project have decided to organize a committee representative of engineers from all over the United States, to press the matter and presumably urge action by Congress calculated to bring about the importation of Chinese labor.

Recent Legal Decisions

CONTRACTS.

LEGALITY OF OBJECT AND OF CONSIDERATION.

(N. Y. Sup.) Buyer's bond to indemnify seller against liability for damages to third party, to whom seller had previously contracted to sell the goods, *held* unenforceable, having been executed as an inducement to seller to break contract with third party, and therefore being based on an illegal consideration, and having been executed for illegal purpose.—Hocking Valley Ry. Co. v. Barbour, 179 N. Y. S. 810.

Restrictive stipulations in restraint of trade in agreements between employer and employe are not viewed with the same indulgence as are such stipulations between seller and buyer of a business and its good will.—Samuel Stores, Inc., v. Abrams, 108 A. 541.

(N. Y.) Parties cannot undertake by an independent provision of a contract to provide for adjustment of differences arising in its performance by arbitration to the exclusion of the courts.—Saratoga State Waters Corporation v. Pratt, 125 N. E. 834.

(N. Y. Sup.) Evidence *held* insufficient to warrant holding that a contract, between corporations involved in the litigation, providing for dissolution of a third corporation formed by them to bid upon and perform subway contracts, either was the result of mistake or was in violation of any laws of New York having reference to the rights of stockholders.—O'Rourke Engineering Const. Co. v. Booth & Flinn, 179 N. Y. S. 623.

PERFORMANCE OR BREACH.

(Cal.) The failure or refusal to perform an obligation assumed expressly or by implication, or the voluntary abandonment of the contract, releases the obligee from the duty of making demand.—Walker v. Harbor Business Blocks Co., 186 P. 356.

(Utah) Where a subcontractor doing the painting on a school building, after being warned that defective materials would not be accepted, falsely assured the inspector for the school authorities that the materials used were substantially those specified in contract, any acceptance of the work based on such false representations of the subcontractor is not binding so as to prevent the general contractor, who would be required to make the deficiency good, from recovering from the subcontractor damages resulting from his failure to comply with the specifications.—Board of Education of Salt Lake City v. West, 186 P. 114.

(Utah) Payment by contractor to subcontractor of a sum to apply on the sub-contract, made before contractor knew that materials used by subcontractor were inferior and not in substantial compliance with the specifications and contract, was not a waiver of such defects.—Board of Education of Salt Lake City v. West, 186 P. 114.

(Tex. Civ. App.) Where subcontractor's contract with road contractor was made subject to all of the conditions and limitations contained in the contract between contractor and county and where such contract did not require contractor to furnish gravel, subcontractor could not recover against contractor for damages sustained by reason of inability to complete work, where such inability was due to default of county to furnish gravel.—Hartwell v. Fridner, 217 S. W. 231.

(Cal.) The failure or refusal to perform an obligation, assumed expressly or by implication, or the voluntary abandonment of the contract, releases the obligee from the duty of making demand, and performance or tender, and justifies him in abandoning the contract without waiting until the contract period expires, and gives him immediate right of action for the breach and to rescind.—Walker v. Harbor Business Blocks Co., 186 P. 356.

(La.) Civ. Code, art. 2765, declaring that the owner may cancel a building contract "at pleasure," but that in such case he must pay the undertaker for the work done and expenses incurred, and such damages as the case may require, has no application where one contract has been superseded by another with the consent of both parties, and the same undertaker appears in both contracts.—Savings & Homestead Ass'n v. Frank, 83 So. 491.

(Cal. App.) Forfeitures are not favored by the courts; every intendment and presumption being against person seeking to enforce the forfeiture.—Horton-Howard v. Payton, 186 P. 167.

ACTIONS FOR BREACH.

(Ala.) If a contract has been fully performed, except payment, or if breached or prevented of preformance by defendant, or abandoned by mutual consent, the planitiff may recover on common counts the amount due, or, as the case may be, for damages for breach of contract.—Moundville Lumber Co. v. Warren, 83 So. 479.

(Ala.) In declaring upon a contract, the pleader must either set out the contract literally or state its legal effect, averring the facts showing defendant's obligation. — Moundville Lumber Co. v. Warren, 83 So. 479.

In declaring on a contract, the pleader must either set out the contract literally or state its legal effect, averring the facts showing defendant's obligation, and, if on parol contract, stating the consideration. —Moundville Lumber Co. v. Warren, 83 So. 479.

(Mo. App.) Plaintiff cannot plead one contract and recover on another, and cannot recover on a contract, an essential part of which is omitted in pleading.—Wamsganz v. Blanke-Wenneker Candy Co., 216 S. W. 1025.

(Tex. Civ. App.) In subcontractor's action against road contractor for damages sustained because of contractor's refusal to furnish gravel wherewith to perform subcontract, where petition alleged an express agreement by contractor to furnish gravel, proof of a contract whereby contractor did not either expressly or impliedly agree to furnish gravel was not admissible; such proof being a material variance from contract pleaded.—Hartwell v. Fridner, 217 S. W. 231.

NEWS OF THE SOCIETIES

June 7-10.—INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE. Annual convention, Detroit, Mich. Secretary, James L. Beavers, Chief of Police, Atlanta, Ga.

June 16-17.—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention. Bemidji, Minn. Executive Secretary, E. L. Bennett, University of Minnesota, Minneapolis, Minn.

June 16-18.—NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual convention, Asheville, N. C.

June 19-21.—TRI-STATE WATER AND LIGHT ASSOCIATION. Tenth annual convention, Atlanta, Ga. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

June 21-23.—CANADIAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Vancouver, B. C. General Secretary, R. D. Defries, M. D., Toronto, Ont.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 21-25.—INTERNATIONAL ASSOCIATION OF ROTARY CLUBS. Annual convention, Atlantic City, N. J. Secretary, Chesley R. Perry, 910 South Michigan avenue, Chicago, Ill.

June 22.—JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-Treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS. Asbury Park, N. J. Office of secretary, Philadelphia.

June 29-July 2.—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Secretary, F. L. Hutchinson, 33 West 39th street, New York.

July 6-8.—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS OF THE STATE OF NEW YORK.- Annual conference, Jamestown, N. Y. Secretary, William P. Capes, 25 Washington avenue, Albany, N. Y.

July 26-30.—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual convention, Toronto, Canada. Secretary, Stephen E. Hoey, Municipal Building, New York.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION. San Francisco. Office of secretary, Boston.

Sept. 7-10.—NEW ENGLAND WATER WORKS ASSOCIATION. Annual convention, Holyoke, Mass. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Boston, Massachusetts.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual convention, San Francisco, Cal.

Sept. 13-17.—SOUTHWESTERN WATER WORKS ASSOCIATION. Annual convention, St. Charles Hotel, New Orleans, La. Secretary, E. L. Fulkerson, Waco, Texas.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 401 Lincoln Avenue, Valparaiso, Ind.

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Engineering Institute of Canada.

At a special conference held in Montreal, April 13, the societies' council was directed to appoint a committee on policy and to approve the establishment by the institute of rate of remuneration for its members.

LOCAL ASSOCIATIONS OF AMERICAN SOCIETY CIVIL ENGINEERS

Illinois Association. Organized 1916. A. F. Reichmann, president; W. D. Gerber, secretary-treasurer, 913 Chamber of Commerce, Chicago, Ill.

The regular meetings of the association are held on the second Monday of March, June, September and December, the last being the annual meeting.

Iowa Association. Organized 1920. J. E. Van Liew, president; R. W. Crum, secretary, Iowa State College, Ames, Iowa.

Louisiana Association. Organized 1914. A. T. Dusenbury, president; Eugene F. Deléry, secretary, 602 Sewerage and Water Board Building, New Orleans, La.

The regular meetings of the association are held at the Cabildo, New Orleans, La., on the first Monday of January, April, July and October.

Nebraska Association. Organized 1917. Clark E. Mickey, president; Homer V. Knouse, secretary-treasurer, 200 City Hall, Omaha, Neb.

Regular meetings of the association are held on the first Saturday of each month, except July and August, and at such places as may be appointed from time to time by the Executive Committee. The annual meeting is held in Lincoln, Neb., on the second Friday in January.

New York Section. Organized 1920. Robert Ridgway, president; Lewis D. Rights, secretary, 256 Broadway, New York City.

The annual meeting is held in May.

Northwestern Association. Organized 1914. Ralph D. Thomas, president; W. J. Jones, secretary, City Engineer's Office, City Hall, Minneapolis, Minn.

The meetings of the association are held bi-monthly, alternating between St. Paul and Minneapolis, on the third Friday of each month.

Philadelphia Association. Organized 1913. S. M. Swaab, president; Henry T. Shelley, secretary, 416 City Hall, Philadelphia, Pa.

The regular meetings of the association are held at the Engineers' Club of Philadelphia, 1317 Spruce street, on the first Monday in January, April and October, the last being the annual meeting.

Pittsburgh Association. Organized 1917. Morris Knowles, president; Nathan Schein, secretary-treasurer, 426 City-County Building, Pittsburgh, Pa.

The annual meeting of the association is held on the first Monday in October.

Portland (Ore.) Association. Organized 1913. J. C. Stevens, president; C. P. Keyser, secretary, 318 City Hall, Portland, Ore.

The annual meeting of the association is held on the second Friday in January. Other meetings are called by the president and are usually convened on Friday evenings.

St. Louis Association. Organized 1888 (constitution approved by board, 1914). Edward E. Wall, president; C. W. S. Sammelman, secretary-treasurer, 300 City Hall, St. Louis, Mo.

The annual meeting of the association, for the election of officers and for the transaction of business, is held on the fourth Monday in November. Two meetings each year, for the presentation and discussion of technical papers, are held in the Auditorium of the Engineers' Club of St. Louis and are open to members of the associated societies. Other "get-together" meetings are held regularly for dinner or luncheon on the fourth Monday of each month except July, August and November.

Municipal Engineers.

At a recent meeting of the municipal engineers of the city of New York, the special topic considered was the inadequacy of pay received by employes in engineering service. Statistics were presented showing that technical men in municipal service received considerably less remuneration than workers in New York building trades and average less than $2,000 per year, while mechanics are being paid $9 per day plus extravagant overtime wages.

The present scale of wages is responsible for lowering the morale of the city's engineering staffs and for the enormous turn-over of 450 per cent. in the Transit Construction Commission in the last six years. The resignation of able department heads on municipal service has caused a marked deterioration in the quality of engineers of the higher grades in municipal service.

The engineer who endeavors to show a low cost of engineering on his work by unduly reducing the technical payroll, was severely criticised. The civil service commission was referred to as an employment agency and it was stated that 5 per cent. of the municipal employes' personnel can profitably be weeded out each year, and that this should be done in order to protect the really valuable men. The city comptroller expressed his opinion that New York City has been "over-engineered."

Tri-State Water and Light Association.

At the 10th annual convention of the Tri-State Water and Light Association of North and South Carolina and Georgia at Atlanta, June 19-21, the subjects discussed will include fuel oil, filteration of water supply and water works extensions. There will also be a display and demonstration of manufacturers' exhibits.

California Section American Water Works Association.

The branch of the American Water Works Association to be known as the California section is now being organized in San Francisco.

PERSONALS.

Genglin, Otto, has been appointed city engineer of Texarkana, Texas.

Heber, Earl, superintendent for the Walsh Construction Co., Davenport, Iowa is in charge of the construction of a $1,000,000 memorial bridge at Wilmington, Delaware.

Sias, R. M., has resigned as engineer of Galveston County, Texas, and opened an engineering office in Galveston.

Hansell, W. A., has resigned as superintendent of public works, Fulton County, Ga.

Miller, A. P., has been appointed assistant engineer for the Canadian Department of Public Works on the Trent Canal.

Latting, B. F., in charge of design of steel hangars for the Army Air Service at Washington, D. C., has resigned to accept a position of assistant chief engineer of the Indiana Bridge Company, at Muncie, Ind.

Wright, John B., has been appointed municipal manager of Springfield, Vermont.

Crawford, Robert, has resigned as superintendent of sewers of Akron, Ohio.

Aikman, H. N., has accepted a position with the Fargo Engineering Company, Jackson, Michigan.

Eichelberger, F. O., City Civil Engineer of Dayton, O., has been made Director of Public Service.

Toner, J. A., was recently appointed superintendent of public works, Meriden, Conn.

Campbell, G. L., has resigned as county engineer of Saline County, Kansas, to become division engineer of the Kansas State Highway Commission.

Boyd, M. C. W., has been appointed general manager and treasurer of the Good Roads Corporation of Kansas City, Mo.

Deleglise, A., has been appointed city engineer of Antigo, Wis.

Bauma, W. H., Omaha, Neb., has been appointed highway commissioner and surveyor of Thayer County, Nebraska.

Brambaugh, John, has been appointed county road superintendent of Huntington County, Indiana.

Starter, H. J., county surveyor of Siskiyou County, California, has been appointed county road engineer of that county.

Russel, G. A., has been appointed highway engineer of Geary County, Kansas.

Von Babo, Alexander, engineer of bridge design, Chicago Department of Public Works, died April 29th. He had had in this country many years experience including positions with the Delaware Bridge Co., the Iron City Bridge Works, Pittsburgh, the Union Bridge Company, and others and had been in the Chicago Department of Public Works since 1899. He assisted in the design of the Chicago type of bascule and invented the operating system therefor.

Winston, J. C., director of public works of Philadelphia, died at Germantown, May 6th. After being chairman of Philadelphia Charter Revision Committee and author of the public works clauses in the Charter, he was appointed director of public works last December.

Miller, J. E., prominent in Chicago's early engineering improvements, died at Evanston, Illinois, April 22nd. He had been connected with the design and construction of the first Chicago Water Works Cribs and sewage system, with the straightening of the Chicago River at its mouth and was associated at one time with the Chicago Dredging & Dock Co.

Bundock, Samuel, one of the original surveyors for the Northern Pacific Railroad in Montana, died at Warm Springs, Montana.

Jones, Major T. H., city engineer of Brantford, Ontario, for 37 years, died April 25.

INDUSTRIAL NOTES.

Automobile Truck Announcement.

E. A. Samels, of the sales department of the Four Wheel Drive Auto Company, Clintonville, Wis., has been appointed assistant sales manager. Mr. Samels, who is well known in the automobile world, received his early experience with the Chicago office of the Locomobile Company of America, which had charge of a number of the company branches and territory supervision over twenty-four states. Later, he acted as special Chicago representative for A. J. Banta, President of th Maxwll Sals Company.

National Lime Association.

At the annual convention to be held at Hotel Astor, New York, June 16, 17 and 18, there are schedules, interesting papers and discussions, and demonstrations on the new electralytic lime treatment of sewage by F. M. Morerck, chemical engineer, Direct Oxidation Process Company, Philadelphia. The use of lime in construction will also be discussed.

Machinery Handling Exhibit.

The Material Handling Machinery Manufacturers' Association has made arrangements to occupy the entire third floor of the Grand Central Palace, New York, at the New York Electrical Show with an exhibit and demonstration of material handling machinery including small trucks, portable cranes, trailers, and the like.

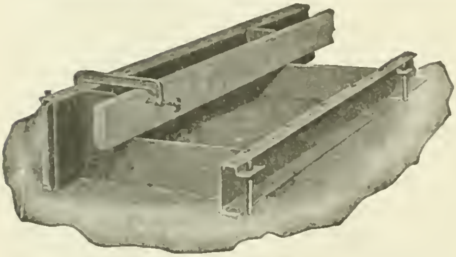
PROBLEMS THAT CITIES ARE STUDYING WITH EXPERTS.

Topeka, Kansas, has contracted with five different engineering concerns to make independent investigations and submit recommendations, estimates of the cost, etc., for providing an adequate city WATER SUPPLY. It is expected that very extensive improvements will be made after the bonds are voted upon and sold.

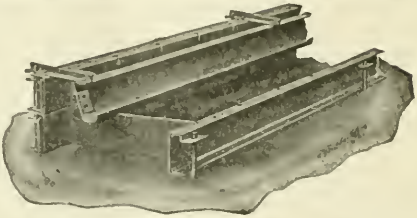
Morris Knowles, Incorporated, Engineers, Pittsburgh, are at present engaged in making comprehensive CITY PLANNING STUDIES at Marion, Indiana. Included in the work outlined are the preparation of topographic and base maps, housing studies, study of streets and utilities, park systems and zoning. This organization is also at present retained to make investigations and report on MUNICIPAL ELECTRIC LIGHTING PLANTS at Richmond, Indiana and Jefferson, Ohio, and has just recently completed similar studies for the City of Ashtabula, Ohio. At Carrollton, Ohio, investigations of the present WATER SUPPLY and plant are under way and a report will be submitted in the near future. Among other activities, the Cleveland office of Morris Knowles Incorporated is now engaged in making a SANITARY SURVEY of the Cuyahoga Conservancy District, while the office at Windsor, Ontario, Canada, along with other work, is engaged in water works design and supervision of construction for Canadian towns near Detroit.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.



UNIVERSAL FORM WITH WOOD FACE FOR COMBINED CURB AND GUTTER.



UNIVERSAL FORM FOR COMBINED CONCRETE CURB AND GUTTER.

BLAW FORMS FOR ROADS AND STREETS.

Steel Blaw forms made in a large variety of standard and special types easily modified, combined and adapted for variations in requirements, have been designed to meet all kinds of street and pavement construction especially in the large majority of cases where heavy plant is used in the grading, surfacing and concreting.

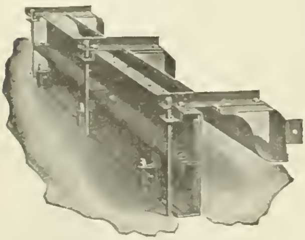
The forms are made duplicate and interchangeable with simple details following closely, a very direct and efficient type of construction and so well devised that the method of application and operation is obvious to any one having even a vague idea of their use and application. They require few repairs, and are easily stored, transported and handled.

They are constructed of sheet metal, bent to exact standards, and with very few fabricated joints so that they are equally light, stiff and durable and can be applied to light or heavy work and to even the most intricate designs of curb, curb and gutter, integral curb and pavement, bituminous surface road and other similar structures.

There are three types of Blaw forms for road and street construction, namely, Universal type forms, and two types of special road forms. Universal forms are adapted to general construction which may include all kinds of curb, gutter and sidewalk work, type "B" special road forms are for use with hand, roller, or belt finished concrete roads and type "C" are for roads where mechanical plant is used for subgrading or finishing.

All sections of forms are provided with the sliding slip joint which is integral with each, locks adjacent sections securely together, and has sufficient flexibility to provide for change of grade and alignment. It permits any section of the form to be removed from the assembled forms without disturbing adjacent sections, and thus enables openings to be made in the forms at any point to permit the entrance and exist of trucks.

Universal forms are made of various heights and of standard lengths of 10 feet with provision for expansion joints every 12 inches. They are securely held in position by steel stakes driven through flange angles and, in special road forms, are locked in position by tapered wedges arranged so that they clear the construction plant that moves on the forms as on rails. The bottom flanges are wide enough to afford hearing for heavy plant on comparatively soft soil and the curb and gutter forms are so designed that they can be assembled in tiers to provide for different lengths of structure.



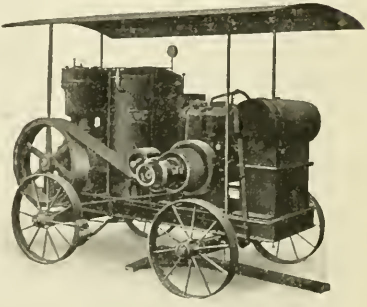
FORM FOR BUILDING CURB AND PAVEMENT INTEGRAL.

VARIOUS MATERIALS.

Trade commissioner H. W. Adams, of Paris, has transmitted copies of the French standard specifications on various materials. gotten out by the Commission Permanente de Standardization of the Ministry of Commerce. These pamphlets may be examined at the Bureau of Foreign and Domestic Commerce by referring to file No. 21289.

CONTRACTORS' PORTABLE COMPRESSOR.

A light, strong, vertical air compressor and receiver mounted on a steel truck and especially designed for general contractors' purposes has been placed on the market by the Chicago Pneumatic Tool Company. The gasoline engine has four water jacketed cylinders and a positive system of circulation with cooling water forced through the jackets and an efficient radiator by centrifugal circulating pumps, one of which is driven by a belt from the compressor shaft and the other is geared from the engine shaft. They are supplemented by a fan installed immediately behind the radiator, and require but little water. All compressors are tested by a shop run previous to shipment and are guaranteed for one year against defective materials or workmanship. With the engine operating at 1,000 r. p. m. and the compressor at 400 r. p. m. the capacity is 140 cubic feet per minute.



AIR COMPRESSOR WITH CAPACITY OF 140 C. F. PER MINUTE.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

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Motor Driven Centrifugal Pumps at Quincy, Ill.

By W. R. GELSTON *

Both low-lift and high-lift pumps, and booster pumps are driven by electricity. The Water Department finds these pumps "economical and very reliable and satisfactory," and the reserve steam equipment is seldom used.

Ten years ago the Quincy waterworks pumping station was equipped with four obsolete, steam-driven, duplex, direct-acting pumps, installed by the company from which the city purchased the plant in 1904. Plans were made for rebuilding the pumping station and installing modern steam-driven pumps. One-half of the old station was removed and a new fireproof building was erected in 1911. There was installed in this building a new Platt Iron Works Company, horizontal, cross-compound, crank and fly-wheel pumping engine, having a daily capacity of six million gallons. The efficiency of this engine, on acceptance test at full capacity, was 130,000,000 foot-pounds per thousand pounds of steam. The water works company paid the manufacturers $17,980 for the pump, erected upon a foundation which was built at the expense of the water company.

By the time this installation had been completed the Keokuk hydro-electric power plant was under construction, and the promotors thereof were making contracts for the distribution of power. The Keokuk company finally made a contract with the Quincy Gas, Electric and Heating Company for the distribution of Keokuk power in the city of Quincy. The water works company then made a contract with the Quincy Gas, Electric & Heating Co. for

VIEW ACROSS STORAGE RESERVOIR DURING ERECTION OF TANK.
Reservoir is 320 feet wide, 420 feet long and 22 feet deep.

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*Superintendent of Water Works, Quincy, Ill.

off-peak power at six and one-half mills per k. w. hour. Under this contract the water company uses juice for lighting the buildings and for operating filter plant motors. It was also granted the privilege of using power at the same rate for a proposed booster pumping station.

At the time the contract was made Illinois screenings were costing $1.40 per ton delivered at the plant; a Worthington, horizontal, triple expansion, duplex, direct-acting pump was in service pumping the water from the river to the filtration plant; and the Platt Iron Works Co. machine, described above, was forcing the water into the distribution system and storage reservoir after filtration.

New pumping equipment had to be installed, and electrically driven machines could be installed at less expense than steam-driven machines, and the change could be made without scrapping steam equipment. Estimates made by the engineers indicated a saving of at least $1,000 per year, under the new contract, by the installation of electric driven centrifugals. Accordingly two electrically driven centrifugals were installed at the river pumping station in 1915. Operating costs have changed rapidly since that time, and, although the Illinois State Public Utilities Commission increased the power rate from six and one-half to seven and one-half mills per k. w. hour on July 1, 1918, the annual saving is undoubtedly much greater now than was anticipated when the power contract was made. Unfortunately the steam equipment, which is maintained for reserve duty, has not been operated enough to furnish reliable data on present steam operating costs, and comparative figures can not be given. Therefore, data on the cost of operating the electric driven units only will be given.

LOW LIFT PUMP.

The pump that is used for lifting the water from the Mississippi river to the filtration plant is a 12-inch, single-stage, horizontal, double suction centrifugal, with a capacity of seven million gallons a day, made by the Dayton-Dowd Company, of Quincy, Illinois. It runs 750 r. p. m., and is direct connected with a General Electric Co. squirrel cage type of motor using 440-v., 3-phase, 25-cycle current.

The operating conditions are such as to prevent uniformly high efficiencies for this pump. It is located on a floor at an elevation 14 feet above low water mark in the river and may operate at one time under a suction lift of 16 feet, or, at another time, under a head of 0 to seven feet, depending upon the stage of the river. The elevation of the water in the forebay at the sedimentation basin is 51 feet above low water mark in the river. Frictional resistance in the discharge line adds about 15 feet to the total lift, and the economy of operation is still further affected by the operation of a float-controlled, hydraulic valve, which regulates the level of the water in the forebay.

During the months of March and April of the present year, the stage of the Mississippi river fluctuated from a minimum of 1.8 feet to a maximum of 19.1 feet and the average power consumption per million gallons pumped during the two months was 249 k. w. hours. The pump discharge was measured by Venturi meter. The cost of this pumping unit complete, with necessary starting equipment, not including foundation, was $1,485.

HIGH LIFT PUMP.

This is a 12-inch, three-stage centrifugal, direct connected with a General Electric Co. 400 h. p. synchronous motor running 750 r. p. m. The normal capacity of the filter plant is six million gallons per 24 hours, and the pump has a capacity somewhat in excess of six million gallons. The filtered water flows by gravity, under a head of from 5 to 10 feet, to the high lift pump suction. The pump discharges into the distribution system, but there is an open storage reservoir, holding about eighteen million gallons, connected with the distribution system at its highest point. The static head under which the pump normally operates is about 210 feet, varying with the depth of water in the storage reservoir. The dynamic head, affected as it is by frictional resistance and the use of water by consumers from the distribution system, averages about 230 feet. The pump discharge is measured by Venturi meter and the average power consumption is 1,130 k. w. hours per million gallons.†

This pump also was installed by the Dayton-Dowd Company and cost, with complete switchboard equipment, $5.178 erected upon a foundation which was built by the water department.

CHESTNUT STREET BOOSTER STATION.

This station is located at the storage reservoir and the pumps take the water from the reservoir and boost it into an elevated tank, which serves the high section of the city. This plant was placed in operation in May, 1919.

There are two Dayton-Dowd, 5-inch, single stage, double suction, centrifugals in this service. They are direct connected with Allis-Chalmers 50 h. p. slip-ring motors running 1,440 r. p. m. Three-phase, twenty-five cycle, 440-volt current is used. The two complete units cost $3,686. The pumps are controlled by means of Sundh Electric Co. automatic, pressure-regulated switches. One pump takes care of the normal consumption in the district, and the automatic switches are set so as to start this pump when about 8 feet of water has been used from the tank. The pump then runs until stopped by the cut-out switch when the tank is full. The switches which control the second pump are set to start and stop it at lower tank stages, and both pumps will cut in only in case of a bad fire, when one pump might be unable to maintain the supply in the tank. The pumps have capacities of about 850 gallons per minute each.

The water usually flows to the pumps under a suction head of from one to five feet. The discharge head, including friction, is 123 feet at starting and about 131 feet with the tank full. The power consumption per million gallons averages 718 k.w. hours. A Venturi meter measures the discharge. The average daily pumpage is about 200,-

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†In a letter to the editor Mr. Gelston says: "On account of a change in the discharge head, which was brought about last summer by cleaning of mains, the pump was not operating so efficiently as before the cleaning, and we had the diameter of the impellers reduced for the purpose of increasing the efficiency. The change increased the efficiency 2½%, and we can improve it still further by cutting the impellers down still further."

000 gallons, which is about 12 per cent of all the water used by the city. In other words, all of the water used in Quincy is pumped twice and approximately 12 per cent of it is pumped three times.

On account of the automatic control at the Chestnut street station the Illinois State Public Utilities Commission would not allow the Power Company to furnish current for its operation at the contract rate of six and one-half mills per k.w. hour (changed to seven and one-half mills by order of the commission on July 1, 1918), as provided in the original contract. The following regular power rates are therefore paid for juice at this station:

	Cents
First 15 kw. hrs used per mo. for each hp. of maximum demand	6
Next 3,000 kw. hrs used per mo..........	2
Next 5,000 kw. hrs used per mo..........	1½
Next 8,000 kw. hrs. used per mo..........	1
Next 15,000 kw. hrs. used per mo........	0.8
For all energy in excess of the above......	0.75

The rates shown are net, after allowing discount for prompt payment of the bill.

The Water Department pays the six cent and the two cent rate for practically all of the juice used at the booster station.

PLANT OPERATION.

The filtration plant and the river pumping station have capacities of six million gallons per 24 hours and are always operated at full capacity. The average daily consumption of water by the entire city is less than two million gallons. The plants are therefore in operation an average of eight hours per day, and the city is using water from the reservoir about sixteen hours per day.

On account of the simplicity of operation with electric power, only three men are regularly employed at the pumping station and filter plants. There is one engineer on duty at the pumping station, and one man attends to the operation of the filter plants while they are in operation. The third man is a night watchman, who looks after the janitor work and keeps the heating plants running in winter while the other men are off duty. One of the foremen of street work lives in a cottage at the reservoir, and he attends to the oiling of the pumps at the Chestnut street station, reads the station meters and gives the plant such attention as may be necessary from time to time.

PUMPING AND PURIFICATION COSTS.

During the first three months of the present year 187,570,000 gallons of water were pumped into the distribution system and reservoir. Of this amount 18,954,000 gallons were boosted into the elevated tank and this represents the amount of water which was pumped three times. All of the pumping was done with electric power.

In its distribution of operating expenses the Water Department charges the cost of operating the low lift pump, including a part of the engineer's salary, to the purification account. All of the cost of operating the booster station is charged to the pumping account. For the first three months of the present year the average cost of pumping one million gallons was $15.36, and the average cost of purification was $16.19, making a total cost of $31.55 per million gallons delivered to the consumer. This figure includes only the cost of labor, power, coagulants, liquid chlorine, oil waste and maintenance of equipment and plant, heat and light.

CONCLUSION.

Electric power has proven economical and very reliable and satisfactory. Lightning has occasionally caused an interruption of the service for periods ranging from a few minutes to two or three hours, and occasionally the voltage drops so low on the line as to burn out fuses; but with several million gallons of water always in storage such interruptions are not at all serious. During the summer months it has not been considered necessary to maintain banked fires under boilers. A banked fire under one boiler heats the pumping station during the winter months. Coal shortages have had no terrors for the water works officials at Quincy.

At a meeting of members of the Contractors' Association of Northern California with the State Highway Commission, the purpose of which was to discuss the mounting cost of road building from the contractor's standpoint, it was stated that the cost of labor had increased 100 per cent in the past five years. The outcome of the meeting was an agreement to appoint representatives on both sides to investigate the situation.

BOOSTER PUMPING STATION AND TANK.
Station is 26 by 34 by 11 feet; cost, $2,241 in 1918; has room for three pumps. Tank is 41 feet in diameter and 34 feet deep, holding 300,000 gallons. Bottom of tank 100 feet above foundation. Cost in 1918, $22,100, for tank; $1,465 for foundation.

Hetch-Hetchy Aqueduct Tunnel

Two sections of the 18-mile concrete lined 11 feet 3 inches by 11 feet 3 inches rock tunnel through the Sierra-Nevada mountains, to deliver 400,000,000 gallons of water to San Francisco daily, are under construction from three headings with most improved and complete power plant and equipment.

Work on the eighteen-mile aqueduct tunnel from Early Intake to Priest Portal (known as the Mountain Division of the Hetch Hetchy Aqueduct) has been carried on continuously by day labor during the past year. Camps have been established at Early Intake Portal, South Fork Portal, Big Creek shaft, Second Garrotte shaft and Priest Portal. These points afford working faces on the longest units of the tunnel aqueduct.

EQUIPMENT.

Tunnel plants have been installed at the working faces, embodying the latest ideas in mining machinery. Standard equipment was selected with the idea of facilitating repairs and minimizing the stock of repair parts. This equipment includes motor-driven Laidlaw feather-valve compressors, Root rotary blowers with 20-inch air pipe, storage battery locomotives with charging apparatus, side-dump roller-bearing tunnel cars, improved Water-Leyner, Sullivan and Waugh rock drills, and air-driven drill sharpeners, with grinders, punches, etc. The track used in the tunnels is of 30-pound T-rails, laid to 24-inch gauge.

A Myers-Whaley mucking machine for loading rock cars has been in use in the Priest heading during the past six months, and has given satisfactory service. This is in the nature of a new departure or experiment in hard rock tunnels of this size, but with the present shortage of labor it unquestionably increases the rate of progress and decreases the cost of the work.

Double-drum motor-driven reversible hoists were installed at the shafts and duplicate installation of equipment to handle the two tunnel headings working from the shaft has been made. An electric motor hoist has been installed at Early Intake tramway and a counterbalanced tramway built at Priest Portal. By means of these tramways, material is delivered from the railroad direct to the tunnel portals.

SHAFTS.

The Big Creek shaft has been completed to its full depth of 646 feet, and the excavation of chambers at and below tunnel grade preparatory to driving the headings is in progress. This shaft has a pumping station, with sump, at a depth of 330 feet. A considerable flow of water was encountered at about the 300-foot level, but moderated

MUCKING BROKEN ROCK IN TUNNEL HEADING WITH POWER SHOVEL.

at lower levels. The water entering the shaft above the pumping station is intercepted and pumped out from the station, instead of being allowed to go to the bottom of the shaft to be pumped out, thus effecting a considerable saving of power. A rock pocket, with provision for loading skips by gravity, has been excavated; also a compartment at tunnel grade, in which tunnel construction equipment can be stored and repaired.

The Second Garrotte shaft has been sunk to a depth of 277 feet. Large quantities of water have been encountered, greatly retarding progress. A pumping station with an 8,000-gallon sump has been cut at a depth of 260 feet.

DRIFTING FULL-SIZE HEADINGS.

On tunnel driving, crews of two shifts have been engaged at Early Intake, South Fork and Priest Portal. During 1919 5,542 feet of tunnel were driven and trimmed to final section, bringing the total tunnel excavated by January 1, 1920, up to 6,379 feet.

All headings are excavated to full tunnel section in one operation, using rounds of from 18 to 24 holes, with from 70 pounds to 100 pounds of 60 per cent to 80 per cent powder. An advance of about 5 feet is made per pound. The cost of labor and powder for driving this tunnel runs from $23 to $30.50 per lineal foot, exclusive of overhead expense, depending upon the character of rock encountered. Most of the rock is granodiorite, schist, or quartzite.

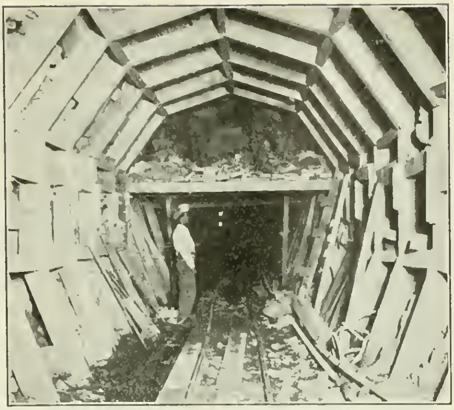
The rock removed from the Priest heading is dumped where it will form part of the down stream toe of the proposed Priest earth fill dam.

The tunnel is driven with a full width bottom heading enlarged at the top by men working on an elevated platform on which the muck is readily delivered to cars running on the service track laid on the invert. Where the rock is unsound, it is braced by skeleton timbering, consisting of light bents about 2 feet apart. Each bent is made of planks, like scarf boards of a single thickness with radial butt joints. The arch portion is made with 4 segments reaching to the springing line, below which there is on each side one vertical intermediate piece and an inclined bottom piece seated on the rock invert. Longitudinal struts or bridges are braced between the bents on the line of every joint which they cover.

SPECIAL MUCKING EQUIPMENT.

The muck is loaded into steel sidedump cars by the Myers-Whaley shoveling machine that was installed primarily on account of the shortage of labor. The machine is about 25 feet long and weighs about 9 tons. It has, at the forward end, a heavy bucket 34 inches wide which is mounted on a swinging arm with a reach of 10 feet each side of the track center and revolves in a vertical plane to empty its contents on an armored belt conveyor which, in turn, delivers to a second elevating conveyor with a transverse motion which enables it to deliver to the car waiting under it at the rear of the machine.

Only three men are required to operate the machine and attendant car, and the mechanism is controlled by two levers. The machine is driven by a 20 h. p. electric motor supplied with current from a reeled cable, and has a rated capacity for 1,000-pound loads and for handling 1 ton of rock per minute with a power consumption of 0.22 k. w. hour per ton of material shoveled.



LIGHT ARCH TIMBERING IN ROCK TUNNEL.

Plastic Clay Method of Dam Construction

An impervious earthen dam 42 feet high with a volume of 45,330 cubic yards was recently built by novel methods to form part of the permanent construction of the Taylorsville earth dam across the Miami river in the Miami Conservancy District.

This dam was built nearly at right angles to the axis of the main dam and on the west bank of the Miami river. It was built during the construction of the main dam but was conducted as a separate and independent operation required to close the east end of the pool maintained in the central part of the dam for its construction by the hydraulic fill process. This dam was made of the same material as the main dam, containing a large percentage of clay, porous enough to admit at first the passage of water.

The material was excavated on the opposite shore of the river by a type 36 Marion steam shovel, which loaded into 12-yard dump cars hauled across the river by a 40-ton locomotive, unloaded by a dragline excavator and deposited by a dragline excavator in a windrow parallel to the axis of the dam. The limitations of the dragline did not permit it to deposit the material nearer than 40 feet to the foot of the western slope of the dam, but the material was made to move itself transverse to the dam axis to the required position by a very simple and effective expedient suggested by G. L. Albert, superintendent of the hydraulic fill work.

The windrow of dry material was built up to a center height of about 10 feet, and 10-foot lengths of gas pipe were driven vertically through it about 3 feet apart in a line about 2 feet east of the center line of the windrow. Water pressure was then applied in the vertical pipes and percolated through the western half of the clayey mass making it plastic until, under the pressure of its own weight, it began to flow in the direction of least resistance, away from the eastern or dry half of the mass and moved continuously along on a very flat slope until it reached the limit staked out for the toe of the dam.

The movement was regulated by injecting more water through the pipe if it became too slow, or by dropping a windrow of dry earth at the foot of the decreasing slope if it was moving too rapidly, the dry earth serving both as a barrier and also to absorb the excess water.

The dragline machines, traveling down the axis of the dam, built up the eastern side by placing materials as required in horizontal layers 10 feet deep, while the west side was forced out to position with fresh material deposited on the slope and each bucket full jetted as it was dumped. The face of the dam was readily moved down a 4:1 slope and assumed the required 2:1 final slope.

About 35,000 yards of the material in the dam were thus deposited by the plastic method and provided an embankment so solid that a 62½-ton dragline machine moved on it without undue setlement. In a test pit excavated in the fill to a depth of 5 feet, the vertical walls stood without signs of flow or break and the damp solid material cut like a cake of putty. In a railroad cut excavated to a depth of 8 feet through the fill, the sides stood without difficulty on a 1:2 slope.

Exposure of Rain Gauges

The following is a brief abstract of a paper recently read in London by M. de Carle S. Salter, superintendent of the British Rainfall Organization, entitled, "The Exposure of Rain Gauges."

As the result of several series of experiments conducted under the direction of the late Mr. G. J. Symons, the adoption of the standard rain gauge, exposed at one foot above ground, has become general in this country. The diminution of catch in rain gauges exposed at greater heights above ground was long thought to be due to a variation in the fall at different elevations, but is now recognized as being caused by wind eddies preventing the rain from entering the funnel. Gauges sufficiently sheltered yield substantially identical results at all elevations above ground. Far too little attention has been given to the provision of proper shelter from strong wind in placing rain gauges. In inland and naturally sheltered localities this precaution may usually be neglected with impunity, but in positions near the sea or at considerable altitudes, shelter, especially on the side of the prevailing wind, is necessary. In such positions the loss caused by elevating the gauge more than one foot above the ground is greater proportionally to the degree of exposure. It is greatly aggravated in the case of snow and still more so should the gauge be of the obsolete shallow funnel type. Rain gauges should on no account be placed on sites where the land slopes downwards on the side of the prevailing wind, or near the top of a cliff or terrace. As a general rule, the loss of catch in faultily exposed gauges occurs principally in the winter months, and, save in exceptional cases, the loss in the summer half year may be safely ignored.

Whilst avoiding over exposure it is equally important to place a rain gauge so that no part of the rain shall be intercepted by objects too near the gauge, more particularly by trees or growing plants.

The existence of errors in rainfall records due to faulty exposure is usually made apparent by the want of harmony with values at neighboring stations observed when plotting rainfall maps. A large number of instances of want of harmony have been specially investigated, the gauges in nearly every case proving to be defective, either in construction or exposure. The degree of disparity which may be taken to indicate error decreases largely with the length of period dealt with, inconsistencies of 25 per cent in a month's rainfall, not explained by the configuration, being sometimes due to variations in the actual fall, whilst in mapping the rainfall of a year, or the average of a series of years, a variation of 5 per cent would probably indicate error.

Ohio Valley Ground Water Supplies

In order to aid in the work of obtaining pure water for domestic and other uses, the United States Geological Survey, Department of the Interior, has made a number of investigations of ground water supplies in the Ohio valley, and now has available for distribution a small stock of its water supply paper 259.

The report covers about 5,600 square miles, approximately one-seventh of the state, which is densely populated. This region receives abundant rainfall, but the streams are far apart and springs few. The waters are for the most part polluted by sewage so as to render them unfit for drinking.

Most of the larger cities in the prairie region along the Ohio valley, especially in Ohio, Indiana and Illinois, are compelled to purify river water for the public supplies. Among those cities maintaining filtration systems for this purpose are Cincinnati, Columbus, Indianapolis, Louisville and many smaller towns.

Electric Lighting Industry

Substitution of hydro-electric energy for the earth's gradually depleting store of coal and oil was the principal problem considered at the annual convention of the National Electric Light Association at Pasadena, California.

In an address, R. H. Ballard, of Los Angeles, president of the association, stressed the importance of co-operation between financial interests and power companies as well as between power companies and consumers and the public in general. He also discussed the credit situation, declaring that twice as much money as heretofore would be necessary to handle even a normal volume of business The industry needs approximately $75,000,000 capital right now to care for the expanded requirements of the country.

Additional Water Supply for New Britain

Porous soil made it impossible to locate storage reservoirs on two of the catchment areas selected, and detention reservoirs, with pipe and tunnel connections to a reservoir in another valley, are planned. Use of ground water also is provided for. This use of detention reservoirs is a novel feature in water works.

Some features out of the ordinary give particular interest to a report submitted a few weeks ago by Allen Hazen, dealing with an additional water supply for the city of New Britain, Conn. This report is addressed to the city engineer, William H. Hall, who, with his assistants, performed a large part of the work of collecting data, making calculations, etc., in co-operation with Mr. Hazen.

PRESENT WORKS.

The municipal water works of New Britain were originally built in 1857, but have been enlarged several times since then. The water supply is obtained from seven comparatively small watersheds, with impounding and storage reservoirs, from which it reaches the city by gravity, giving pressures ranging from 20 to 111 pounds in the different parts of the city. The largest of these reservoirs is Shuttle Meadow reservoir, which has a capacity of 1,347 million gallons. Wolcott reservoir has a capacity of about 140 million gallons and Burlington reservoir about 100 million. A 24-inch cast iron main extends from Shuttle Meadow reservoir to the center of the city, the reservoir being just outside the southwest corner of the city limits. Another 24-inch cast iron pipe leads to the city from Burlington reservoir, about 8½ miles west of the city.

The present supply is sufficient to yield 7 million gallons per day in dry years. The exact rate of output is not known, and cannot be measured easily. The water is sold by meter measurement, and the amount as measured averaged 4.65 million gallons per day in 1919; but the amount used in public buildings, street sprinkling and other public purposes is not measured, and if to this be added under-registration of meters and leakage from mains, it is probable that the total consumption reaches 6½ million gallons. It is thus apparent that there is urgent need for increasing the supply.

Most of the present sources are high in elevation, and with little population on the water-shed. Large parts of the areas are owned by the city, so that the present favorable conditions can be controlled and made permanent. These areas produce great quantities of water during the winter and spring floods and relatively small amounts at other seasons of the year. This demonstrates the necessity for storage in order to utilize the available supply. The present storage available is only 1,600 million gallons.

PLANNING FOR THE FUTURE.

Mr. Hazen's study was made on the basis of future population of 150,000 to be supplied with 15 million gallons per day. To develop this quantity and maintain it in a dry year, it will be necessary to have 5 or 6 billion gallons of storage. His calculation of available supply is made on the basis of an average annual "water crop" of 23 inches of run-off, or 400 million gallons per square mile.

Although much of the spring floods is now lost for lack of storage, there is deep sand over much of the water-shed area, and the natural flow of the brooks is well maintained in dry seasons. It was calculated that 90 per cent of the entire run-off, less evaporation, can be made available by a net storage equal to 82 per cent of the mean annual flow—that is, a storage adequate for 335 days' consumption. This may be taken as the approximate economical limit for present local conditions.

Shuttle Meadow reservoir gives relatively adequate storage capacity for the area directly tributary, which area includes 1.4 square miles the run-off from which is collected by two canals, which conduct the water to this reservoir. Two other considerable areas, however, known as the Whigville and Burlington Brook areas are provided with little storage. For this reason it suggested itself that the most desirable location for additional storage would be on these areas. The 24-inch line now leading from the Burlington reservoir would suffice for a number of years to bring to the city the water from these areas.

Three sites for storage reservoirs on these areas were studied. "The one on Burlington brook looked most promising. An excellent basin of ample capacity could be controlled by a relatively small dam at a point where the brook flows over rock bottom. Everything above the surface of the ground was favorable. The geological arrangement underground, as disclosed by the borings, is most unfavorable. The hill on the right bank of the brook is coarse sand and gravel. The brook runs through a rock saddle which was the prospective dam site; but borings show that this saddle is not at the lowest point of the rock. Farther up the stream there is another and lower outlet to the right, filled with well-drained sand and gravel which is capable of carrying away large quantities of water if a reservoir were built on this site.

"The samples which I examined showed material, much of it with effective sizes which I estimated to be 0.5 mm. and some of it coarser. Mechanical analyses were not made because, on inspection of these materials and on studying the borings, it was apparent that a storage reservoir could not be built upon this site.

"It should be stated that it was not merely a matter of added difficulty and expense. The gravel-filled valley is so wide and deep that it would be impracticable to secure a suitable cut-off, and the material now filling it is so coarse in grain that a reservoir built without such a cut-off would leak too badly to be useful.

"The idea of building a storage reservoir on this point was therefore reluctantly abandoned.

"It then seemed that the most promising site for a reservoir to give a large part of the required storage was below Whigville. Surveys were made of this site and borings were made where a dam could be located. In this case also the borings disclosed sand and gravel of such a degree of coarseness and of such depth as to make the construction of a dam and reservoir impracticable.

"As the reasons for not using these sites may be questioned in years to come by others not familiar with the present circumstances, it is my suggestion that record plans showing all the data should be made and placed in your files, and that the samples of materials taken from the borings, and now in the City Hall, should be preserved to satisfy those who come after."

DETENTION RESERVOIRS.

"With these two sites eliminated, there remained only the Harts Mills site, and here also conditions were not very favorable. In this case the left bank of the stream is a sand and gravel bank. The brook runs through a rock saddle which makes an attractive dam site. No large amount of storage can be secured in a reservoir built on this site, nor is there assurance that the dam can be made tight, but it is proposed to use it, building a dam of moderate height for the purpose of retarding the flow of flood waters and permitting them to be diverted through a smaller pipe than would otherwise be needed.

"Used in this way, the Harts Mills reservoir will only be filled during periods of ample flow. Otherwise it will stand empty. Seepage from it is to be expected, but the seepage will be to the present Whigville reservoir, and the water will be ultimately saved." A capacity of 264 million gallons is planned for this reservoir. The average annual yield of this shed is estimated at 1,500 million gallons.

The stream flowing through the proposed Harts Mills reservoir and through the existing Whigville reservoir lower down is separated from Burlington brook by high land, and the plan proposed is to bring the water from the Burlington brook to the Whigville reservoir by means of a tunnel 4,700 feet long with an approach channel and a small diverting dam. This tunnel was considered preferable to a much longer pipe line around the hill, and further, it would not be practicable to build a pipe line large enough to carry the flood flow of Burlington brook, while the tunnel will carry practically all of such flow. As a possible alternative to the tunnel, Mr. Hazen suggests a small detention reservoir on the brook lower down and a pipe line or canal leading to a new intake dam. The annual yield of this area is estimated at 1,720 million gallons.

None of these reservoirs, however, provides much additional storage, and it was decided that the only practicable storage obtainable was at Shuttle Meadow, where the existing dam could be raised considerably, and the reservoir area greatly increased. The only disadvantage is that it is separated from the cachement areas that will furnish most of the water. "This defect can be corrected by providing pipes of capacity sufficient to carry the greater part of the flood flows. Pipes large enough to carry extreme flood flows would be too expensive; but by securing a certain amount of retardation of flood flows by relatively small reservoirs, pipes of moderate size can be made to carry a large percentage of the water to the point of storage.

"Diversion of the flows in this way presented an interesting and somewhat novel problem in hydraulics. The question was to find how large the pipe capacity must be, and the effect of a retarding reservoir; and in short, to find the most economical combination of pipe line and reservoir that would give sufficiently complete development."

In making this study, use was made of the records of flow in the Manhan river, which is part of Holyoke's supply, the records of which had been kept for 19 years. Conditions on this stream are so closely comparable with the Whigville and the Burlington areas, that this basis of estimate was used with confidence.

Calculations were made to determine "the most economical sizes that would secure the diversion of all the water that it would pay to divert, without, on the other hand, going to extremes that would make the cost of the last water excessive." As a result of this study, Mr. Hazen states that it is possible to divert 98 per cent of the flows of the Whigville and Burlington areas above the present Whigville dam, by the use of detention reservoirs of practicable size and pipes from them to the Shuttle Meadow reservoir.

From the detention reservoir at Harts Mills, a 36-inch pipe line would be laid (passing the present Whigville reservoir and having a cross-connection with it) for a distance of about 7 miles, where it would be cross-connected with the 24-inch pipe from the Whigville reservoir. Here the line would be increased in size to 42-inch and carried 4 miles further to the back end of Shuttle Meadow reservoir. By this arrangement the combined capacities of the present 24-inch pipe and the new 36-inch pipe from Harts Mills and Whigville reservoirs would both be utilized, and the supply from both would be carried by the 42-inch to the Shuttle Meadow reservoir. By this method the run-off from the Burlington and Whigville areas will be brought to the large storage reservoir proposed at Shuttle Meadow.

In addition there is an area of about 11 square miles below the Whigville dam which it may seem desirable to make use of. The only method practicable for doing so appears to be to locate a pumping station at the lower end of this area and to pump the water from there into Shuttle Meadow reservoir.

SHUTTLE MEADOW RESERVOIR.

Shuttle Meadow is a natural basin almost surrounded with high walls of trap. The floor of the enclosed valley is almost flat. The present reservoir is formed by a relatively low dam. By building a higher dam, the capacity of the reservoir can be greatly increased.

Surveys made to determine the capacity of the reservoir and the dimensions of the dam required, if the reservoir be raised 50 feet above its present level, showed that this will increase the storage to 6,000 million gallons and permit a delivery of more than 18 million gallons a day. There is no apparent reason why the reservoir could not be built 80 feet above the present level and the storage capacity thus be increased to 10,000 million gallons.

"The dam site is between masses of trap rock at either end. The few borings that were made disclosed red sandstone rock underneath the site at a depth of about 50 feet below the present floor of the valley. These borings were not numerous enough to develop all the underground conditions, and further borings along the center line of the proposed dam site will be needed before plans can be made."

The material above the rock at this point consists of clay, sand, broken rock and boulders, most of it sand containing fine material which renders it much less pervious to water than that found at the other sites. It was assumed that it would be necessary, however, to obtain a complete cut-off of underground flow by carrying to rock either an open trench back-filled with concrete or clay, or caissons, or sheet piling of wood or steel. An estimate is made of $300,000 for cut-off works, both in the bottom and at the right bank.

This seemed a large sum to spend for this precaution, and it is possible that further borings and studies may prove it to be unnecessary. But as this reservoir is just outside the city and the topography is such that, in case of a break, the released water would pass through part of the city, it seemed prudent not only to take this precaution, but also to make the dam thicker than would be considered necessary in another location. This extra thickness of dam was also used in the design to make possible raising it to a great height in the future, if this should be found desirable. Details of the plan of the dam were not worked out, as the final design should be based upon more complete knowledge concerning the materials available in the neighborhood for constructing the dam and also the soil underneath it.

As this dam is largely in the nature of a storage reservoir rather than an intercepting one, in that it receives the direct surface flow of only about one-sixth of the total utilized area, while the flood flows on the other tributary areas are regulated by retarding reservoirs, the top need be carried only a few feet above the proposed flow line and a spillway is almost unnecessary. It happens, however, that there is on one side of the reservoir a valley through the trap rock and at the right elevation for a spillway, and this forms a natural spillway which will make it impossible to fill the reservoir higher than is safe for the embankment.

OTHER FEATURES OF THE PLAN.

It is taken for granted that the city will desire to filter its supply, as has been done for some years at Springfield and New Haven, and as is being done at Hartford. A site was found for a filtration plant near the reservoir and at such elevation that the water from the upper 25 feet of the proposed reservoir would come to the filters by gravity. As the reservoir under normal working conditions would seldom be drawn down more than 25 feet, most of the water used through it would flow to the filters by gravity, while the rest of the water, which would be required only in dry times, would be made available by pumping. For this purpose a centrifugal pump operated by a 100 horse-power electric motor is recommended. Offsetting the necessity for occasional pumping is the advantage that having the filters at this height increases to the maximum the gravity pressure available in the city.

At present the pressure in the city is lower than is desirable, partly because the reservoir itself is rather low and partly because the pipe line from the reservoir is not of sufficient capacity. By the proposed plan the filters will be 25 feet above the present flow line in this reservoir, and a new pipe line will be built to the city, the combined result of which will be that the pressure will be about 10 pounds higher than its present maximum.

The coarse sand found at the Burlington and Whigville dam sites suggested the practicability of securing ground water by wells in this sand. Two advantages of this would be that a very considerable natural storage in the ground could be availed of, and the quality of the water would be better. Water so obtained would not need to be stored in the Shuttle Meadow reservoir nor to be filtered. It would be partly but not wholly additional to that obtained as surface water by the damming of the streams.

The water now being intercepted by two canals, one on each side of the valley, and brought to Shuttle Meadow reservoir, could not be discharged into the reservoir by gravity when the dam has been raised 50 feet, but would be discharged into a small basin at the foot of the main dam and lifted into the reservoir by means of an electric pump. Water so obtained would not cost more than $4 or $5 per million gallons.

ORDER OF DEVELOPMENT.

As the Shuttle Meadow reservoir is now the most important source of supply for the city, these plans must be carried out in such a way as not to interfere with the use of this supply until at least an equal amount is available in some other way. Mr. Hazen describes in some detail the order in which these plans should be carried out to secure this end.

As bringing additional run-off to Shuttle Meadow reservoir by means of the various elements of the plan described would serve little purpose unless there were storage capacity for retaining it, the first work should be the enlarging of that reservoir. First it will be necessary to drive a tunnel in solid rock around the end of the present dam and carry it well beyond any point that may be reached by the proposed new dam; which new dam would be located just below the present one. This tunnel must be connected with the reservoir and a gatehouse provided, and also connected with the pipes leading to the city, so that the supply can be drawn through this tunnel rather than through the pipes leading from the present dam, which pipes would be removed when the new dam is started. The new dam would then be constructed.

As this work would not be completed for several years, while the consumption will be increasing, some means are necessary for adding to the supply during this interval, and it is suggested that for this purpose the development of the ground water above referred to be adopted. Two million gallons a day obtained in this way could be brought to the city by the present pipe leading from the Whigville reservoir and should suffice until the new Shuttle Meadow reservoir is ready for service.

The third instalment of work would consist of the construction of the filters. The fourth would be the Harts Mills reservoir and the steel pipe line bringing that supply to the Shuttle Meadow reservoir. The fifth and final work would be the bringing in of the Burlington brook supply by the construction of the tunnel and its appurtenances.

The cost of the whole works is estimated at $4,800,000, of which $830,000 is for the filtration plant. This gives a cost (including filtration) of $409,000 per million gallons maintainable capacity. This figure seems large, but would have been not more than 60 per cent. as large if it had been made a few years ago when prices were lower.

Oklahoma Water Supply and Sewerage

The engineer of the State Board of Health describes conditions in the state at present. Most of the sewage treatment plants are so operated as to be valueless.

The engineer of the State Board of Health of Oklahoma is required by law to make a survey of the water and sewerage conditions of the state: investigate all water supplies in the state to determine whether or not the public health is endangered by the poor quality of the water and order changes necessary to safeguard the public health; investigate all sewer systems and sewage treatment works to determine whether the public health is being endangered by stream pollution and order the necessary remedies; make tests to determine the best method of purifying water and sewage; and pass on all plans for new work in water supply and sewerage. As the engineer, J. W. Evans, has no assistants, although he reports that six sanitary engineers would be required to perform all of this work, he has found it possible only to pass upon new plans and make partial investigations of water and sewer systems up to date.

OKLAHOMA WATER SUPPLIES.

In the report published this year and brought up to March, he gives a general summary of the water and sewerage situation in the state. There are at least 233 and probably a few more water supplies in the state, practically all municipal, only three private ones being known of. The municipalities supplied have a total population of about 850,000, of which 500,000, living in 75 municipalities, are supplied with surface water and the remainder with well water.

The surface waters of Oklahoma in nearly all cases either are so polluted by sewage or contain such large quantities of suspended matter that they are unfit to drink without previous purification. About 20 cities in Oklahoma are treating their water with chlorine. Most well waters in the state, and especially those in the western half, are hard and undesirable. Thirty-three municipalities using surface water are attempting to purify it, 24 of them operating sand filters and 8 merely using coagulants to settle out the impurities. There are two filters of the pressure type in use and several have been discarded. One was installed at Yale to separate mud from the water of a typical red creek without preliminary treatment, but the filter clogged in a few minutes, required about all the filtered water for washing purposes, and was soon discarded.

SEWERAGE SYSTEMS.

There are about 110 sewer systems in Oklahoma serving communities with a population of about 700,000, of which about 500,000 are connected with the sewers. The sewage is in most cases disposed of by discharge into streams, either raw or after passing through a septic tank. Many sewage treatment plants have been installed, but their purpose has generally been to protect the municipality against damage suits rather than effectively to purify the sewage. The office records show about 40 septic tanks, 15 Imhof tanks, a dozen sprinkling filters, several contact beds, 7 electrolytic plants and one activated sludge plant. Of the electrolytic plants, only one is now in operation and that only a few hours a day. The activated sludge plant is located at Yale and is not yet in operation.

From observation made on perhaps half of the plants, it appears that they "are operating at about 30 per cent. efficiency. Moreover, very few plants have been built that are really capable of getting good results, and when neglect is added to faulty design, the results are best described by the statement that the purification plant does not do the sewage much harm. It is customary to leave the sewage plant alone until a complaint is received from those offended by the sewage. Quite frequently I have found that none of the municipal officials know where the sewage plant is located. This indifference on the part of municipal officials should be considered by engineers in designing treatment works. A sewage plant should be as simple and as nearly automatic in its operation as it can be made, and definite instructions for operating the plant should be attached to the plans."

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Water Works Costs

In the annual review of certain features of water works conditions throughout the country which, in conformity with our long-established practice, we give this week, we have selected the matter of costs as being of most interest to water works officials, and present several tables showing how these have increased in all sections of the country. Roughly speaking, the increase in the materials which count most in the annual expense accounts average about 150 to 175 per cent. This is more than the general increase in the cost of labor or of living expenses, and much more than the increase made in water rates.

Next week we expect to publish additional figures from the same cities, showing to what extent water rates have been increased, and also the wages of employes and the salaries of superintendents. The failure to raise water rates will furnish food for thought, and it would seem for action also.

Detention Reservoirs

The plans of the Miami Conservancy District now being carried out provide for what are believed to be the largest dams ever constructed for the purpose of flattening out the peak of the storm run-off of a drainage area rather than for long-time retention of the run-off.

In fact, the idea is one that has not often been employed. It is therefore interesting to find, in a recent report, a proposal to embody the idea in a scheme for impounding water for a public water supply.

In the preliminary plans for New Britain described in this issue, Allen Hazen proposes using detention reservoirs in order to reduce the size of pipe necessary for carrying to a storage reservoir the total run-off of even maximum storms from drainage areas not directly tributary to such storage reservoir.

As already explained in connection with the Miami dams, the general idea is that of providing an outlet to the dam which is never closed and which will carry all of the ordinary flow of the stream, as a result of which the reservoir would ordinarily remain entirely empty. During storms, however, all of the run-off would not be passed by the outlet as rapidly as it reached it, but the surplus would accumulate in the reservoir, to flow out gradually, as the storm flow decreases, at such a rate as the capacity of the outlet permits.

In the plans for New Britain, the outlet consists of a pipe carrying to a storage reservoir the run-off from a drainage area which would not otherwise reach it. This pipe would ordinarily carry the entire flow from such area and it is only when its capacity is exceeded by storm run-off that the surplus would accumulate in the reservoir. If the reservoir were not provided, or were merely a small intercepting one, the pipe would need to be very much larger and more expensive, or else a considerable part of the excessive run-off would fail to enter the pipe and would be lost. From the point of view of economy, it is possible to so proportion the size of pipe and capacity of reservoir, increasing one and decreasing the other, or vice versa, as to reduce to a minimum the combined cost of the two.

Another advantage of detention reservoirs is that they greatly reduce the capacity necessary in the waste weir of the storage reservoir, since they hold back temporarily from such reservoir the maximum floods. In fact, it suggests itself that it might be advantageous in some cases to build, on each of the several tributaries to an impounded stream, a dam of cheap construction which need not be made water-tight, such as one made of logs or rock fill, but which would be sufficiently tight to hold back temporarily the storm run-off from the area above it.

The idea is most interesting, and is one which may find additional applications in the designing of hydraulic works where conditions are favorable to its adoption, as they were at New Britain.

Preserving Records of Investigations

Another feature of the New Britain report which deserves mention is the suggestion of the engineer that the results of the investigation which has been made, including all data and samples of materials from borings, as well as the conclusions, be preserved by the department as a part of its records "to satisfy those who come after," "as the reasons for not using these sites may be questioned in years to come by others not familiar with the present circumstances."

It has happened several times that studies made for municipalities or states and which have resulted in conclusive determinations for or against certain proposals, have been filed away and, the officials connected therewith having changed during the next few years, the taxpayers' money has been wasted by again investigating the same projects and with similar conclusions. Or, as has more frequently happened, the conclusions having been acted upon, new officials ignorant of the reasons for reaching these conclusions have questioned their wisdom and may even have undone work already performed on them and thus incurred a loss which would not have happened had they been able to review the facts and reasoning on which such conclusions were based.

It is the duty of every engineer to his client to make thorough investigation of problems on which he reports and have clear and definite reasons for his conclusions; and the data as well as the conclusions should be furnished in full to the client. The engineer owes it to himself to report the data and reasoning and to do all that is in his power to see that they are permanently recorded, in order that they may serve as a defense of his reputation in case the wisdom of his decision should be called in question by succeeding officials. A further reason for this preservation of such records in their entirety is in order that they may be used understandingly and with confidence by succeeding investigators of related problems or of extensions of the same problem. In fact, this last is perhaps the use that will most frequently be made of data so preserved.

Recent Immigration Figures

Immigration at Ellis Island, which receives approximately 80 per cent of the immigrants reaching this country, continues to show an encouraging increase. While during the whole of 1919 only 141,132 immigrants were received at all ports, about 150,000 landed at Ellis Island alone during the first five months of 1920. The encouragement of this figure is partially off-set by the fact that of this year's number, about half have been widows and small children, and therefore of little industrial value to the country. Most of the others have been Italian reservists who have been here before as laborers and know beforehand what and where they expect to work.

The figures for this year are as follows: January, 25,051; February, 22,086; March, 29,098; April, 36,958; and May (figures not yet available) will total over 40,000. Byron H. Uhl, Assistant Commissioner at Ellis Island, states that he looks for about 50,000 in June and still larger numbers during July and August.

Figures published by the Bureau of Immigration covering the one hundred years ending with 1919 show that the total immigration during that time was 33,200,103, of which Great Britain and Ireland contributed 25 per cent, Germany 16 per cent, Italy and Austria-Hungary each about 12 per cent, Russia 10 per cent and Scandinavia 6½ per cent. 1914 was the record year with a total of 1,218,480, with 1913 next highest when 1,197,892 immigrants were entered. These figures are for the entire country and not the port of New York alone. In 1913, 23 per cent of the immigrants were Italians, while in 1919 only 1.3 per cent of the 141,132 were of that nationality.

Federal Labor Court Proposed

Establishment of a federal court of industrial relations, similar to that in Kansas, was recommended before the senate labor committee May 21, by Governor Allen, of Kansas.

"I would recommend legislation that would take into consideration the fact that the peace and welfare of the public must come first," said Governor Allen.

"I would urge the creation of a court having all the powers of any court below the supreme court, whose appeals should be to that tribunal; the judges to be appointed by the President."

The Governor said, however, that this court should have jurisdiction relating only to interstate commerce and that there should be no provision that would in any way interfere with the rights of states to adopt similar measures dealing with intrastate commerce.

Philadelphia Longshore Strike

The United States Shipping Board has issued the following statement:

The longshoremen's organization at Philadelphia, which is not affiliated in any way with the International Longshoremen's Association, has made a demand for a 25 per cent increase in wage rates and some 4,000 men have gone on strike. This organization was under an agreement with employers and the Port of Philadelphia, expiring Sept. 30, 1920, by which its members were assured the prevailing longshore wage rates upon the Atlantic Coast. This agreement has apparently been disregarded and great delay and damage to shipping in the Port of Philadelphia is resulting.

"The present basic deep sea longshore wage rate on the Atlantic Coast is 80 cents per hour. The demand of the striking longshoremen calls for a dollar an hour. As the present rate was set by a commission which gave careful and thorough investigation to all of the factors involved, including the cost of living, there is no justification for an increase in the basic hourly rate."

Too Much Alien Labor Leaving America

It is estimated that 200,000 Poles in the United States will return to their native country to help in the establishment of free Poland. Applications for passports to Poland are being received at the rate of 1,000 a day, but there are transportation facilities for only about 800 passengers a month.

Italians are returning to Italy in large numbers, but they are not staying. Post-war conditions in Italy apparently do not attract the Italian who has become accustomed to high wages in the Untied States.

Italian Immigration

The Chicago Italian Chamber of Commerce, with a membership of 175, all but two of whom are United States citizens, has submitted a resolution to Congress, calling for opposition to all bills to suspend immigration, to restrict it on a percentage basis or to subject immigrant aliens, and aliens visiting this country, to unnecessary and vexatious regulations.

It asserts that restriction of immigration on a percentage basis is openly intended to encourage immigration from Germany and restrict it from Italy.

The body also went on record in favor of Senator Kenyon's measure appropriating $6,500,000 for Federal co-operation with the several States in the education of illiterates.

In the week ending May 29, the number of immigrants landing at the port of New York was six times as great as those of aliens qualifying to leave the country.

Aliens are now arriving at about one-third the rate they landed here in the last year before the war. In many countries emigrants have difficulty in securing permission to leave the country where the working force has been depleted by the war and where in some cases large armies are still maintained, leaving an inadequate provision for civil operations, which are much more highly paid than formerly and this also tends to decrease the incentive for emigration. In Poland 8,000 passports were issued during the month of May.

P. A. Baker, superintendent of U. S. Immigration Station, Ellis Island, says that immigration is increasing by leaps and bounds and that the aliens arriving here during the past few weeks have exceeded the number departing for their native lands by many thousands.

On its last arrival in New York, the liner Henry R. Mallory brought 1,000 former Italian soldiers all able-bodied and ready for work, which, it is reported, they obtained without leaving the dock, where they were met by the representative of a large rubber company who offered them satisfactory employment.

Water Resources of North Carolina

The State Geological and Economic Survey is to investigate the water resources for power and municipal supplies, studying drainage, flood control, irrigation, rainfall, stream flow, etc.

The following notice has been sent to municipal officials of Carolina, under date of April 29th, by Joseph Hyde Pratt, director of the North Carolina Geological and Economic Survey:

The North Carolina Geological and Economic Survey is about to initiate a thorough study and investigation of the water resources of the state. This will include such subjects as water power, municipal water supply, drainage, flood control, irrigation, the compilation of rainfall and stream flow data, etc. The investigation will be undertaken by dividing the state into districts, each one of which will be investigated and a report prepared. Work will be undertaken first in such districts as apply, in the order of their application for service, and in the general degree of importance which the investigation would have to the people of the state. Municipalities, chambers of commerce, manufacturers, agricultural associations, and individuals may make application for one or more specific purposes. A field party will begin in June to conduct investigations.

Expenses.—The applicant will be expected to defray 50 per cent of the field expenses for such an examination. This is necessitated by the small amount of funds appropriated for this important work.

Waterpower.—North Carolina is rich in waterpowers of less than 5,000 horsepower. There are numerous municipalities and industries in the state which could obtain their light and power cheaper by local hydro-electric development. Indeed, in some instances industries have left the state because they could not get adequate power, although undeveloped waterpowers were near by. The increasing cost and difficulty in obtaining coal have made the development of our waterpowers imperative. Moreover, on account of the increasing use of electricity on the farm, it is of great importance that our agricultural population should benefit by the natural resources of the state, which are only awaiting development. It is for these reasons that the "Survey" is undertaking this study and investigation. It is prepared to co-operate with one or a number of towns or industries in the development of local waterpowers.

Water Supply.—With the rapid growth of our towns and cities, the problem of an adequate water supply is becoming increasingly acute. The "Survey" will co-operate with municipalities in an investigation of the water resources of a district suitable for water supply and will suggest methods best adapted for the utilization and development of these resources.

Drainage.—The "Survey" has investigated and been instrumental in the creation of the great drainage projects now under way or completed in the state. It will gladly aid similarly in the formation of new districts and in the promotion of drainage work for malaria prevention.

River Regulation for Flood Control and Navigation.—The regulation of the flood flow of streams to prevent damage to municipalities or agricultural lands is becoming of increasing importance. It is frequently possible to combine this improvement with one of the other developments described above. In certain parts of the state, notably on the Catawba, waterpower developments have served to regulate the flood flow and prevent much damage which previously occurred to farm lands, towns and structures at high stages of the river.

The increasing agricultural and industrial development of the state has necessitated greatly increased facilities for transportation of products. In some instances this can be met by improving the existing waterways of the state, so that they may be more suitable for navigation. The "Survey" is prepared to investigate and report upon the feasibility of projects of river regulation for flood control or navigation.

Flood Control and Forestry.—The maintenance of a satisfactory forest cover on the watersheds is of vital importance in the regulation of stream flow and control of floods. The Federal government has already purchased in North Carolina 350,000 acres of mountain land and is protecting it for this avowed purpose. The state should at once adopt a similar policy. The protection of private lands on the headwaters of streams, through co-operation between the owner, the Federal government and the state, is now being worked out. The effect of the destruction of the forest (mainly through uncontrolled lumbering and forest fires) upon stream flow and erosion of valuable agricultural lands will be further investigated by the "Survey" and the results laid before the people.

Delay in Starting New Highway Work

In spite of the millions of dollars available for highway construction this year, there has been a most unusual delay in awarding contracts for new work in the eastern states. In fact, Commissioner Green of New York State has been quoted as saying that he does not intend to award any contract for new work to be performed this year, one of the reasons which he advances being that there is a large amount of work yet to be done on uncompleted contracts hanging over from last year, and even before then, and that these will probably suffice to use all of the available labor and material; while the awarding of new contracts at higher rates would probably result in the new contractors' being able to out-bid those endeavoring to complete old contracts in the securing of both labor and material, and thus in working an added hardship to the latter class of contractors and possibly further delaying or even entirely preventing the completion of the older contracts.

It is probable that the same arguments influence to a greater or less extent the highway authorities of other states in causing them to defer the awarding of contracts, although such decision has undoubtedly been influenced considerably by the high bids and the small number of bidders. For instance, of 39 total items on which bids are to be opened on June 15 at Harrisburg, Pa., 22 are readvertisements, and on several, bids have been requested a number of times since last July. One of the items is now being offered for the ninth time, there having been received on it, during the previous eight times, 1 bid, 2 bids, 3 bids, 3 bids, 2 bids, no bids, no bids and 2 bids, respectively. Another item has already been up for contract seven times, no bids having been received the first 6 times, and only two bids the 7th time. Each of these two items consisted of one-course reinforced concrete, as does a large part of the work offered for contract by the Pennsylvania Highway Department.

Prices in 1914 and Now

Figures furnished by water works officials in all parts of the country, giving prices paid in 1914, 1919 and 1920 for various materials, fuels, electric current, etc., show that these have more than doubled in price. The figures are tabulated on the following pages.

In order to obtain some definite information from all sections of the country concerning increased cost of water works materials and to learn whether prices had apparently begun to fall in any section, last month we sent a questionnaire to superintendents throughout the country, and publish in this issue a tabulation of the replies which we obtained in this way.

The prices asked for were those for cast iron pipe and special casting, wrought iron or steel pipe, meters (¾-inch being taken as the size for comparison), valves (6-inch being used for comparison), fire hydrants (those with two hose and a steamer outlet being taken for comparison), lead, coal, electric current, fuel oil, and lime and soda ash used by purification plants.

Every one of the materials named showed not only an increase in price in 1919 over 1914, but also an increase in 1920 over 1919, indicating that at the time of making purchase or giving contracts during the present year, prices had not declined since last year. There were a few instances in the case of some of the materials where slightly lower prices were obtained this year than last, and quite a number where the prices this year were the same as those of last; but in the great majority of cases this year's prices showed an appreciable increase over last year's.

Averaging the prices paid by the several cities in each of the three years, we find the following results:

Cast iron pipe in 1914 brought an average price of $26.25 per ton. By 1919 the price had risen to $61.50, and this year the average of the prices reported from all sections of the country is $74.81—an increase of 185 per cent over the 1914 price.

The special castings have increased a little less—170 per cent since 1914; the prices paid, in cents per pound, being 3.08 in 1914, 6.49 in 1919 and 8.32 in 1920.

The prices given for wrought iron or steel pipe were for so many different sizes that it is useless to average them; but the increase between 1914 prices and those of 1920 was obtained for each city and the average of these percentages of increase is 116, the percentage of increase for the individual cities varying from 19 to 220.

¾-inch meters were reported as costing an average of $10.16 in 1914, $12.89 in 1919 and $14.77 in 1920. These figures give an increase of 27 per cent between 1914 and 1919, and 45 per cent between 1914 and 1920.

6-inch valves were reported as costing on the average $11.82 in 1914, $22.84 in 1919 and $24.46 in 1920; this showing an increase of 93 per cent between 1914 and 1919, and 107 per cent between 1914 and 1920.

Fire hydrants were reported as costing on the average $30.64, $54.96, $60.17 for the three years, respectively, showing increases of 79 per cent in 1919 and 96 per cent in 1920.

Lead is reported as costing, during the three years named, 5.01 cents, 8.05 cents and 10.35 cents; showing an increase of 61 per cent and 107 per cent for 1919 and 1920, respectively.

The prices paid for coal vary considerably in different parts of the country, and according to kind of coal used, the prices reported for 1914 varying from 60 cents to $9.12 a ton. An average of all the prices reported between these limits would, therefore, have no special significance; but as practically all of the cities reported the prices paid in each of the three

PRICES PAID FOR WROUGHT IRON OR STEEL PIPE. AVERAGES FOR 1914, 1919 AND 1920.

		Average Price Paid in		
City and State	Unit	1914 Cents	1919 Cents	1920 Cents
Alabama:				
Mobile	¾" per foot	3.75	....	8.38
California:				
Palo Alto	2" galv. ft.	12	28.7	....
Connecticut:				
Putnam	ft.	5.1	10.6	12.2
Southington	1" pipe ft.	7	12.9	12.7
Delaware:				
Lewes	3" & 6" pipe, ft.	38-32	65-150	75-170
Wilmington	¾"	5.5	10	10.5
Georgia:				
Thomasville	¾" galv. ft.	4.07	8.51	8.91
Idaho:				
Lewiston	Conv. joint g & d ft.	32.30	60.50	75
Weiser	¾" ft.	4.5	....	10.5
Illinois:				
Bushnell	ft.	....	....	115
Du Quoin	ft.	4.25	6.5	8.3
Indiana:				
Evansville	ft.	6.5	13	14
Terre Haute	¾" galv. ft	5	10.17	10.8
Iowa:				
Sioux City	2" ft.	18	22.5	26
Kansas:				
Fredonia	....	8	11.5	....
Fort Scott	....	3	....	8.5
Louisiana:				
New Iberia	....	8	....	13
Maine:				
Lisbon Falls	....	......	12	11
Maryland:				
Hagerstown	1" galv.	12	22	22
Massachusetts:				
Athol	ft.	6.50	11.50	11.50
Mansfield	ft.	....	....	8.74
Maynard	ft.	....	....	15
Millbury	....	3.91	11.50	....
Somerville	galv. ft.	1"-5.4	.16	.13
		2"-15.6	.38	....
Springfield	ft.	7.3	16.83	18.53
Woburn	ft.	....	37.00+2%	....
Worcester	ft.	1"-3.5	6-7	7-8
Michigan:				
Battle Creek	ft.	7.70	13.75	15.50
Onaway	3"	28	....	....
Minnesota:				
Lake City	ft.	7	14	17
Stillwater	ft.	½"-4.352	9.62	....
	ft.	¾"-6.313	11.87	....
	ft.	1"-7.854	17.06	....
Mississippi:				
Jackson	ft.	4	7.85	8.35
New York:				
Ogdensburg	ft.	6-8.5	¾"-10.35; 1"-15.35	....
North Carolina:				
Charlotte	ft.	4.5-5	12	16
Raleigh	ft.	1"5.3; ¾"-3.8	1"-10; ¾"-8.5	1"-12.96; ¾"-8.75
Ohio:				
Newark	ft.	5	....	7.77
Van Wert	¾" ft.	6.25	7.22	7.44
Wilmington	4" as basis ft.	26.87	65.56	63.38
Oregon:				
Eugene	4" pipe ft. dipped & wrapped	30.08	....	106.75
Portland	2" ft.	10.93	28.44	....
Pennsylvania:				
Clearfield	ft.	6	10	12
Indiana	ft.	.35	14.37	1"-15.75
Tennessee:				
Murfreesboro	ft.	½"-4; 1"-7	½"-6.75; 1"-9	½"-7; 1"-10
Texas:				
Taylor	2" 10,000 ft.	16½	....	....
Virginia:				
Charlottesville	ft.	½"-2"-8	11	15
Wisconsin:				
Fon du Lac	ft.	6.66 2-3	12	12.25
Wyoming:				
Green River & Rock Springs	ft.	72	1.41	....

years, the average was obtained for each year as a means for determining the average increase in cost. This method showed an increase of 81 per cent between 1914 and 1919 and 111 per cent between 1914 and 1920. In other words, the cost of coal to the water works pumping plants has increased nearly half as much during the last few months as the total increase during the five years previous.

Those using electricity for power have been more fortunate. The increase in cost of electric current for pumping plants has not been nearly as great as of coal, and in some cases the price is even less this year than it was six years ago. About forty per cent of the cities report no change in the price paid for current since 1914. On the other hand, those using oil for fuel have had to pay a much greater increase than users of coal. The least increase reported was 37 per cent, while the highest is 400 per cent, and the average per cent increase has been 230 per cent.

In the matter of lime for purification plants, the increase has varied from 5 per cent to 300 per cent, the average increase being 93 per cent. Of the four cities reporting price on soda ash, one reports a 40 per cent decrease in price, another 27 per cent decrease, the third 33 1-3 per cent increase, and the fourth 150 per cent increase.

It appears from the above that material for new construction costs on the average at least 2½ times as much as it did six years ago, although the meters show an increase of less than 50 per cent. For pumping plants, coal is the large item and the price of this is approximately double what it was. It would seem that water works departments and companies would be justified in increasing their rates to meet these increased costs. The total cost to be met by the rates includes, of course, not only materials and salaries, but also interest and depreciation on the plant, and this might be estimated as showing no increase; although, if it should be necessary to replace any parts of the plant before prices fall to previous levels, this would make a demand on the depreciation account 50 to 100 per cent larger than was provided for. We have received figures from the several superintendents showing to what extent they have increased their water rates during the past twelve months, which figures we are expecting to publish next week. The increases which were made by them up to a year ago were given in our annual water works summary of June 7 last year.

PRICES PAID FOR CAST IRON PIPE. AVERAGES FOR 1914, 1919 AND 1920.

	Average price per ton paid in		
City and State	1914	1919	1920
Alabama:			
Gadsden	$20.00	$45.75	....
Mobile	25.75	67.00	$75.00
California:			
Palo Alto	34.00	91.20	97.50
San Francisco	28.00-26.00	83.20-69.55	94.55-84.55
Colorado:			
Boulder	.....	77.00	84.00
Colorado Spgs.	32.00	....	68.00
Delta	....	....	97.50
Connecticut:			
Putnam	23.75	59.50	....
Southington	24.85	50.90	80.00
Winsted	22.50	....	....
Delaware:			
Lewes	30.50	36.00	....
Wilmington	20.50	57.10	65.00
Florida:			
Pensacola	25.00	56.00	....
Georgia:			
Albany	....	....	....
Cedartown	20.00	55.00	55.00
Thomasville	21.95	55.00	....
Idaho:			
Weiser	45.00	....	....
Illinois:			
Mattoon	22.00	67.00	70.00
Monmouth	32.15	....	....
Quincy	23.00	51.20	67.00
Rock Island	25.00	58.00	....
Waukegan	23.00	60.00	80.00
Indiana:			
Columbia City	23.50	54.60	61.10
Evansville	21.75	55.00	63.50
Garrett	....	59.80	78.00
Kendallville	33.15-30.15	....	77.70-80.80
La Porte	23.25	51.80	69.80
N. Manchester	26.00	72.50	....
Richmond	24.35	....	....
Terre Haute	22.25	50.00	77.80
Iowa:			
Algona	27.50	....	....
Cherokee	32.00-25.76	62.60-59.60	....
Sioux City	23.25	65.25	79.60
Kansas:			
Council Grove	....	65.00	....
Emporia	31.20	70.70	70.50
Fort Scott	35.00	75.00	65.00
Kentucky:			
Providence	19.00	63.00	....
Louisiana:			
New Iberia	24.00	....	73.00
Maine:			
Lisbon Falls	43.50	....	....
South Paris	25.90	....	86.00-90.00
Maryland:			
Hagerstown	22.50	62.00	60.00
Massachusetts:			
Athol	22.50	74.00	74.40
Mansfield	21.60	....	70.00
Maynard	....	64.00	....
Millbury	27.01	75.00	....
New Bedford	21.75-22.25	46.00	64.00-71.00
Somerville	22.70	57.00	....
Springfield	21.65	....	63.00-70.00
Winthrop	22.90	70.00	80.00
Woburn	23.00	70.00	....
Worcester	21.20	....	....
Michigan:			
Battle Creek	22.35	57.80	72.80
Belding	25.00	....	....
Crystal Falls	30.50	....	69.75
Highland Park	22.00	56.00	....
Lansing	23.25	51.80	51.80

PRICES PAID FOR CAST IRON PIPE. AVERAGES FOR 1914, 1919 AND 1920 (Continued).

	Average price per ton paid in		
City and State	1914	1919	1920
Ludington	$23.00	$54.00	$73.90
Manistique	25.00	54.70	84.00
Onaway	32.00	....	....
Saginaw	23.70	51.75	73.40
Minnesota:			
Lake City	28.50	68.00	66.00
Rochester	23.30	56.00	76.30
Stillwater	24.40	59.30	....
Mississippi:			
Greenwood	....	50.00	70.00
Jackson	24.85	62.50	72.00
Missouri:			
Chillicothe	24.50	85.00	80.00
Montana:			
Havre	....	72.30	83.62
Nebraska:			
Hastings	38.00	62.00	73.00
New Jersey:			
Bridgeton	29.00	65.00	72.00
Hawthorne	22.00	....	....
New York:			
Albany	21.00	55.50	89.50
Norwich	23.40	74.50	74.50
Ogdensburg	23.00	59.00	76.00
Potsdam	26.50	56.00-80.00	....
Syracuse	25.40	51.40	73.00
Watervliet	....	56.00	....
Wellsville	30.00	....	....
North Carolina:			
Charlotte	22.50	62.50	....
Henderson	24.00	56.00	74.00
Raleigh	22.00	55.90	69.30
Ohio:			
Barnesville	35.00	65.00	80.00
Coshocton	23.00	.....	68.00
Delaware	28.00	42.00	67.00
Lakewood	22.50	67.00	77.00
Martins Ferry	....	53.60	94.05
Newark	24.00	72.00	....
Niles	22.00	66.80	72.80
Van Wert	....	65.00	....
Wilmington	30.00	78.00	110.00
Oklahoma:			
Perry	43.00	65.00	80.00
Sapulpa	....	64.00	....
Oregon:			
Portland	30.20	70.35	87.63
Pennsylvania:			
Clearfield	20.50	67.50	....
Indiana	23.90	60.90	67.50
Reading	20.50	50.34	....
Sewickley	21.50	52.10	77.10
Stroudsburg	21.00	56.00	72.00
Tennessee:			
Dyersburg	27.00	55.00	65.00
Murfreesboro	43.00	65.00	....
Texas:			
McKinney	30.00	....	73.00
Stamford	24.00	....	57.25
Taylor	26.00	58.00	....
Temple	26.50	....	....
Waco	26.50	65.00	70.00
Virginia:			
Charlottesville	30.00-34.00	66.00	75.00
Richmond	22.00	57.58	74.46-80.40
Washington:			
Auburn	....	73.80	....
Spokane	42.50	76.30	87.00
Wisconsin:			
Fond du Lac	24.80	51.00	51.00
Janesville	....	53.40	64.40
Oconomowoc	23.55	....	....
Wyoming:			
Cheyenne	....	70.00	90.00
Green River and Rock Springs	34.32	68.00	....

PRICES PAID FOR SPECIAL CASTINGS. AVERAGES FOR 1914, 1919 AND 1920.

	Average price per ton paid in		
	1914	1919	1920
City and State	Cents	Cents	Cents
Alabama:			
Gadsden	4.0	10.0	....
Mobile	2.75	....	7
California:			
Palo Alto	4.125		7.75
San Francisco	3.5	8.0	9.95
Colorado:			
Boulder	....	6.0	7.5
Colorado Springs	2.75	....	7.25
Delta	...	10.0	....
Connecticut:			
Putnam	4.0	5.0	....
Southington	2.75	5.5	....
Winsted	4.0	....	....
Delaware:			
Wilmington	2.7	6.0	10.0
Florida:			
Pensacola	5.5	10.0	10.0
Georgia:			
Thomasville	2.6	5.5	....
Idaho:			
Lewiston	3.0	5.0	5.0
Weiser	6.0	....	....

PRICES PAID FOR SPECIAL CASTINGS. AVERAGES FOR 1914, 1919 AND 1920 (Continued).

City and State	Average Price Paid In		
	1914 Cents	1919 Cents	1920 Cente
Illinois:			
Mattoon	2.75	6.0	....
Monmouth	4.25	....	....
Quincy	2.75	5.375	6.85
Rock Island	2.5	6.0	....
Waukegan	3.0	5.0	7.0
Indiana:			
Columbus City	3.5	6.5	7.5
Evansville	2.75	5.0	7.5
Garrett	...	5.75	7.4
Kendallville	2.5	5.5	7.34-7.84
La Porte	2.75	5.84	6.59
Richmond	2.75	....	....
Terra Haute	2.75	5-5.5	7.39
Iowa:			
Algona	3.5	....	....
Cherokee	2.75	5.9	....
Sioux City	4.5	6.75	7.25
Kansas:			
Council Grove	....	5.9	....
Emporia	3.0	7.0	7.5
Maryland:			
Hagerstown	3.0	9.0	9.0
Massachusetts:			
Athol	4.0	8.0	8.5
New Bedford	2.75	5.75	7.25
Somerville	4.67	13.73	14.51
Springfield	5.5	....	....
Winthrop	3.5	....	....
Woburn	....	20.75	22.825
Worcester	3.0	8-10	10-15
Michigan:			
Battle Creek	2.45	5.5	6.8
Belding	2.75	....	....
Highland Park	2.65	8.0	....
Manistique	3.0	....	7.0
Lansing	2.75	6.0	6.0
Ludington	2.5	6.0	8.0
Saginaw	2.75	5.5	7.0
Minnesota:			
Lake City	4.0	9.0	9.5
Rochester	3.0	5.0	6.0
Stillwater	2.75	5.25	....
Mississippi:			
Jackson	2.75	4.75	5.75
Montana:			
Havre	....	5.25	6.25
Nebraska:			
Hastings	4.0	7.0	8.0
New Jersey:			
Bridgeton	4.5	5.0	7.5
New Mexico:			
Roswell	....	7.0	7.0
New York:			
Albany	2.5	....	....
Norwich	3.0	....	....
Ogdensburg	2.75	6.0	7.5
Potsdam	3.5	5.75	....
Syracuse	2.5	5.5	10.0
Watervliet	....	5.5	...
Wellsville	2.75	....	....
North Carolina:			
Charlotte	2.5	5.75	8.5
Raleigh	2.75	3.5	6.5
Ohio:			
Barnesville	4.0	6.0	8.0
Delaware	2.9	....	6.55
Lakewood	2.75	....	8.75
Martins Ferry	....	4.89	....
Newark	2.75	....	....
Niles	2.75	6.0	6.59
Van Wert	....	5.875	....
Oklahoma:			
Perry	3.0	4.5	8.0
Oregon:			
Portland	2.38	....	8.0
Pennsylvania:			
Clearfield	2.75	....	....
Indiana	14.0	7.0	....
Reading	2.5	5.75	....
Sewickley	3.5	5.0	6.25
Stoudsburg	2.5	6.5	7.5
Tennessee:			
Dyersburg	3.0	4.5	4.5
Murfreesboro	5.0	7.0	....
Texas:			
McKinney	....	....	6.7
Taylor	3.0	5.5	....
Waco	2.0	4.0	5.5
Virginia:			
Charlottesville	3.5	5.5	6.5
Richmond	2.5	6.0	7.5
Washington:			
Auburn	....	5.0	....
Spokane	4.0	8.5	8.5
Wisconsin:			
Fond du Lac	2.75	5.25	5.25
Janesville	....	5.5	7.42
Wyoming:			
Green River & Rock Springs	4.4	6.6	9.6

PRICES PAID FOR LEAD. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Per Pound Paid In		
	1914 Cents	1919 Cents	1920 Cents
Alabama:			
Gadsden	3.78	7.50	.....
Mobile	4.55	.....	.....
California:			
Palo Alto	4.70	9.00	8.10
San Francisco	4.93	6.09	8.31
Colorado:			
Boulder	.....	9.00	12.00
Colorado Springs	7.20	.....	10.00
Delta	.....	8.00	.....
Connecticut:			
Putnam	5.80	8.75	.....
Southington	4.50	6.50	10.00
Winsted	4.60	.....	.....
Delaware:			
Lewes	6.00	20.00	19.00
Wilmington	5.50	9.00	9.00
Florida:			
Pensacola	5-5.50	10.00	.....
Georgia:			
Albany	.....	.....	9.00
Cedartown	5.00	11.00	.....
Thomasville	4.94	7.00	.....
Idaho:			
Lewiston	5.50	.....	8.20
Weiser	7.00	.....	.....
Illinois:			
Mattoon	3.20	7.80	9.00
Monmouth	9.00	10.50	11.75
Quincy	4.05	5.40-6.12	.....
Rochelle	.....	.....	11.75
Rock Island	4.00	7.50	.....
Waukegan	5.00	8.00	11.00
Indiana:			
Columbus City	4.00	5.375	8.50
Evansville	4.50	5.00	5.50
Kendallville	8.00	8.75	9.75
La Porte	5.00	12.00	11.50
North Manchester	2.75	8.50-14	.....
Terre Haute	4.07	5.85	9.00
Union City	5.00	10.00	.....
Iowa:			
Algona	7.50	9.00	.....
Cherokee	4.75	5.25	.....
Sioux City	3.50	11.00	11.00
Kansas:			
Council Grove	.....	7.00	.....
Emporia	.....	11.00	11.25
Fredonia	5.50	8.50	.....
Fort Scott	3.50	.....	10.50
Kentucky:			
Providence	4.00	12.00	.....
Louisana:			
New Iberia	4.75	.....	12.00
Maine:			
South Paris	.....	.....	12.00
Maryland:			
Hagerstown	5.50	11.00	9.00
Massachnsetts:			
Athol	4.25	6.45	.....
New Bedford	4.225	6.30	.....
Somerville	4.19	5.60-7.15	.....
Springfield	3.84-4.225	5.58	7.65
Winthrop	4.24	8.95	10.50
Woburn	.....	6.60	9.95
Worcester	23.85	8.00	8.00
Michigan:			
Battle Creek	4.17	5.75	9.75
Belding	4.95	.07*	.....
Crystal Falls	5.00	.....	14.00
Highland Park	3.80	9.50	.....
Lansing	4.50	7.80	9.59
Ludington	4.50	.....	11.00
Manistique	5.00	.....	.....
Onaway	6.00	.....	.....
Saginaw	5.00	7.00	10.00
Minnesota:			
Hutchinson	.....	.....	10.75
Lake City	7.00	9.00	12.00
Rochester	6.00	9.00	12.00
Stillwater	4.65	7.50	.....
Mississippi:			
Greenwood	.....	.....	10.00
Jackson	4.50	8.50	12.00
Montana:			
Havre	.....	7.50	9.75
Nebraska:			
Hastings	6.00	10.00	11.00
New Jersey:			
Bridgeton	4.50	7.00	10.00
Hawthorne	6.00	.....	.....
New Mexico:			
Roswell	.....	10.00	11.75

PRICES PAID FOR LEAD. AVERAGES FOR 1914, 1919 AND 1920 (Continued)

City and State	Average Price Per Pound Paid In 1914 Cents	1919 Cents	1920 Cents
New York:			
Albany	4.35	.....	9.20
Norwich	5.50	6.66 2-3	.....
Ogdensburg	5.00	5.70	10.00
Potsdam	6.00	7.60	.....
Syracuse	4.85	6.00	10.00
Watervliet	5.00	.....	.....
Wellsville	6.75	.....	.....
North Carolina:			
Charlotte	7.90	9.00	10.00
Henderson	5.20	7.50	14.00
Raleigh	4.75	10.00	10.00
Ohio:			
Barnesville	4.00	6.00	12.00
Coshocton	4.00	.....	10.00
Delaware	4.65	7.65	9.00
Lakewood	7.25	8.50	10.00
Newark	4.25-5.00	8.00	10.75
Niles	4.95	7.00	11.50
Toronto	5.00	15.00	.....
Van Wert	.....	6.25	12.00
Wilmington	5.00	6.50	10.50
Oregon:			
Portland	4.19	.....	.....
Pennsylvania:			
Clearfield	3.90	6.25	.....
*Sewickley	6.00	9.00	9.75
Sharpsville	5.25	7.50	.....
Tennessee:			
Dyersburg	6.00	8.00	8.00
Murfreesboro	3.50	7.00	9.00
Texas:			
McKinney	5.00	.....	8.00
Temple	6.00	.....	.....
Waco	.....	10.00	12.00
Virginia:			
Charlottesville	5.50	9.00	10.75
Richmond	4.60	9.00	9.21
Washington:			
Auburn	.....	.....	10.00
Spokane	.....	6.5357	.....
Wisconsin:			
Fond du Lac	4.05	5.75	9.40
Janesville	.....	6.50	9.75
Wyoming:			
Cheyenne	.....	7.00	12.00
Green River & Rock Spring	5.00	.....	.....

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*Scrap lead.

PRICES PAID FOR METERS, ¾ INCH. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Paid In 1914	1919	1920
Alabama:			
Gadsden	$12.00	$20.00	.....
Mobile	6.00	9.95	$11.76
Palo Alto	8.60	11.97	11.97
San Francisco	.....	18.00	19.50
Colorado:			
Colorado Springs	22.00	.....	36.00
Connecticut:			
Southington	12.00	16.20	19.50
Winsted	10.00	.....	.....
Delaware:			
Lewes	7.00	9.00	10.00
Wilmington	7.95	16.20	16.20
Florida:			
Pensacola	6.40	9.50	.....
Georgia:			
Albany	.....	.....	9.50
Cedartown*	8.40	10.80	12.00
Thomasville†	7.74	11.61	11.61
Valdosta	.....	10.00	10.00
Idaho:			
Lewiston†	8.00	12.00	12.86
Weiser	8.50	.....	11.20
Illinois:			
Bushnell	11.50	9.50	.....
Chicago Hgts †	8.40	8.40	.....
Mattoon	8.00	11.00	11.00
Monmouth *	9.50	10.50	12.97
Quincy	10.71	.....	15.10
Rochelle	.....	.....	10.39⅓
Rock Island	9.00	12.00	.....
Sparta	.....	9.75	.....
Waukegan *	8.00-10.00	10.76	13.00
Indiana:			
Columbia City	12.60	18.75	19.50
Delphi *	7.00	12.00	13.00
Evansville	7.55	12.26	.....
Garrett	.....	8.80	10.00
Kendallville *	7.00	10.50	.....
Lebanon	8.40	10.50	10.50
No. Manchester	7.85	12.10	16.00
Richmond*	8.00	.....	.....
Shelbyville	9.50	15.00	.....
Terre Haute	15.00	18.00	20.40

PRICES PAID FOR METERS, ¾ INCH. AVERAGES FOR 1914, 1919 AND 1920 (Continued).

City and State	Average Price Paid In 1914	1919	1920
Iowa:			
Algona	$7.00	$8.00	$8.50
Cherokee*	.....	11.84	11.84
Sioux City	12.60	17.75	.....
Kansas:			
Council Grove	.....	11.50	11.50
Fredonia*	10.00	11.64	11.80
Fort Scott*	10.00	.....	14.00
Kentucky:			
Providence	12.00	14.50	.....
Louisiana:			
New Iberia	8.25		11.50
Maryland:			
Hagerstown	11.75	18.00	19.50
Massachusetts:			
Lenox	11.85	12.50	.....
Mansfield*	8.40	.....	19.395
Millbury*	8.40	10.00	.....
New Bedford	7.95	.....	18.00
Somerville	9.80	14.25	.....
Springfield	12.00	.....	.....
Winthrop	12.60	14.17	.....
Woburn	12.00	14.25	13.80
Worcester	12.00	15.00	16.00
Michigan:			
Battle Creek	12.00	15.00	15.75
Belding*	.....	12.60	.....
Charlotte	6.35	9.00	9.50
Highland Park	12.00	14.25	.....
Lansing	12.60	.....	.....
Onoway	12.80	.....	.....
Minnesota:			
Cloquet	8.60	12.60	.....
Hutchinson	8.00	10.00	13.00
Lake City*	14.00	15.00	16.00
Rochester	12.80	12.80	23.40
St. Peter	.....	8.75	8.75
Mississippi:			
Canton†	.....	10.75	10.75
Jackson	16.00	17.50	20.00
Montana:			
Havre	.....	16.20	6.20
Nebraska:			
Hastings	12.50	16.60	16.85
New Jersey:			
Hawthorne	6.25	.....	.....
New Mexico:			
Roswell*	10.80	10.80	11.60
New York:			
Albany	11.34	.....	.....
Norwich*	7.30	.....	10.75
Ogdensburg	12.00	.....	.....
Watervliet	.....	10.20	10.20
Wellsville	8.40	10.70	10.70
North Carolina:			
Charlotte*	6.50	10.21	10.60
Henderson	7.35	11.00	11.00
Raleigh	13.50	15.00	19.50
Ohio:			
Barnesville	8.25	14.00	16.25
Coshocton	8.40	.....	12.60
Delaware*	7.00	10.80	.....
Lakewood*	7.00	10.71	10.71
Newark	12.60	.....	.....
Niles	12.00	.....	18.90
Van Wert	7.50	10.00	.....
Wilmington*	.....	10.00	11.00
Oklahoma:			
Perry	12.40	14.60	.....
Oregon:			
Eugene	.....	.....	10.00-13.00
Portland	10.00	.....	.....
Pennsylvania:			
Clearfield	15.00	18.00	18.00
Indiana	13.50	13.50	13.50
Reading	11.34	.....	13.00
Sewickley	15.00	24.00	26.00
Sharpsville	7.50	11.00	.....
Tennessee:			
Dyersburg	9.60	10.50	12.00
Murfreesboro*	6.40	12.00	14.50
Texas:			
Georgetown	11.35	15.00	17.00
Stamford	22.00	.....	32.00
Taylor	10.50	16.50	.....
Temple†	11.60	12.00	14.50
Waco	10.60	18.00	19.80
Virginia:			
Charlottesville¶	9.50-11.50	17.00-11.00	12.00-14.00
Richmond	8.25	12.40	14.25
Washington:			
Auburn	?	10.61	.....
Chehalis	12.00	18.00	22.00
Wisconsin:			
Fond du Lac*	6.20	10.39	10.40
Janesville	.....	13.50	14.85
Oconomowoc	8.40	12.60	12.60
Wyoming:			
Green River and Rock Springs‡	8.00	.....	12.60

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*—⅝-inch meters. †—⅝ and ¾-inch. ¶—⅝ and 1-inch. ‡—⅜-inch.

PRICES PAID FOR VALVES, 6 INCH. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Paid In 1914	1919	1920
Alabama:			
Gadsden	$14.00	$37.50	.....
California:			
Palo Alto	8.72	.....	.....
San Francisco	.....	25.25	$27.85
Colorado:			
Boulder	.....	23.95	.....
Colorado Springs	13.00	.....	17.50
Connecticut:			
Putnam	7.80	23.73	18.25
Southington	10.00	23.10	25.00
Delaware:			
Lewes	16.00	28.00	.....
Wilmington	7.95	16.20	16.20
Florida:			
Pensacola	9.00	25.00	.....
Georgia:			
Thomasville	7.69	16.61	.....
Idaho:			
Lewiston	11.85-13.90	23.40-27.75	32.00
Weiser	11.60	.....	.....
Illinois:			
Quincy	11.65	21.78	23.95
Rochelle†	.....	.....	15.20
Rock Island	16.00	21.00	.....
Waukegan	12.00	23.00	30.00
Indiana:			
Columbia City	.....	26.35	.....
Delphi*	7.00	12.00	13.00
Evansville	11.00	.....	.....
Garrett	.....	20.00	25.00
Kendallville	13.00	22.00	25.00
La Porte	12.80	20.75	22.85
Richmond	12.00	.....	.....
Terre Haute	11.75	20.80	.....
Iowa:			
Cherokee	10.00	11.90	.....
Sioux City	10.25	14.00	21.95
Kansas:			
Emporia	10.70	24.20	.....
Louisiana:			
New Iberia	7.50	.....	18.00
Maine:			
South Paris¶	.....	.....	37.80
Maryland:			
Hagerstown	13.80	24.25	.....
Massachusetts:			
Athol	13.50	.....	22.75
Milbury	18.20	.....	.....
New Bedford	10.50	21.83	24.00
Somerville	10.50	20.79	22.85
Springfield	13.00	36.40	26.00
Winthrop	11.95	20.79	25.00
Woburn	11.00	17.65	.....
Worcester	9.00	16.00	22.00
Michigan:			
Battle Creek	11.50	21.80	25.00
Belding	7.00	11.40	.....
Crystal Falls	9.85	.....	23.50
Highland Park	10.50	22.00	25.00
Lansing	10.00	19.97	.....
Ludington	10.52	20.00	.....
Manistique	18.00	23.70	27.70
Saginaw	10.50	20.80	25.00
Minnesota:			
Lake City	23.00	38.00	40.00
Rochester	15.00	.....	26.00
Stillwater	12.60	21.78	.....
Mississippi:			
Jackson	12.00	22.50	27.00
Montana:			
Havre	.....	23.76	27.00
Nebraska:			
Hastings	16.25	22.00	28.75
New York:			
Albany	11.00	20.80	.....
Norwich	11.00	23.12	.....
Ogdensburg	12.60	20.79	25.00
Potsdam	18.00	.....	.....
Syracuse	12.50	21.30	27.50
Wellsville	10.50	.....	.....
North Carolina:			
Charlotte	8.00	19.50	21.50
Raleigh	11.20	24.20	24.00
Ohio:			
Barnesville	6.50	12.25	14.50
Delaware	16.20	.....	20.25
Lakewood	9.21	18.75	20.75
Martin's Ferry	.....	32.50	.....
Niles‡	27.00	.....	.....
Van Wert	.....	32.50	.....
Oklahoma:			
Perry	28.00	51.00	.....
Oregon:			
Eugene†	.....	.....	20.00
Portland	7.65	.....	23.50
Pennsylvania:			
Clearfield	11.00	.....	.....
Indiana	12.50	23.10	.....
Reading	7.60	20.80	25.00
Sewickley	12.60	20.00	24.00
Stroudsburg	11.00	.....	26.00
Tennessee:			
Dyersburg	10.00	12.00	14.00
Murfreesboro	14.00	.....	.....
Texas:			
McKinney	.....	.....	28.00
Taylor	9.50	17.50	.....
Waco	10.80	22.77	25.00
Virginia:			
Richmond	7.60	20.79	25.00
Washington:			
Auburn	.....	20.47	.....
Spokane	14.00	26.31	29.45
Wisconsin:			
Fond du Lac	8.12	23.72	23.96

*—⅝-inch. †—4-inch. ¶—8-inch. ‡—10-inch.

PRICES PAID FOR HYDRANTS, 2-WAY AND STEAMER. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Paid In 1914	1919	1920
Alabama:			
Gadsden	$22.50	$46.00	.....
Mobile	28.50	.....	$53.00
California:			
Palo Alto	26.50	52.00	66.00
Colorado:			
Colorado Springs*	68.00	.....	70.50
Connecticut:			
Putnam	.....	45.00	.....
Southington†	24.50	54.00	54.50
Winsted	27.00	50.00	.....
Delaware:			
Lewes	25.00	42.00	.....
Wilmington	29.50	53.41	.....
Florida:			
Pensacola	25.00	54.00	.....
Georgia:			
Cedartown ¶¶	24.00	45.00	.....
Thomasville	23.95	50.03	.....
Idaho:			
Lewiston¶	35.00	47.50	68.85
Weiser	52.26	.....	.....
Illinois:			
Mattoon	22.00	67.00	.....
Monmouth	56.00	76.00	.....
Quincy	36.00	65.25	66.75
Rochelle¶	.....	.....	52.00
Rock Island	48.00	75.00	.....
Waukegan	40.00	80.00	105.00
Indiana:			
Columbia City	27.50	46.00	67.00
Delphi	28.50	.....	.....
Evansville‡	31.00	54.50	63.25
Garrett	.....	35.00	54.50
Kendallville	26.50	54.00	54.00
La Porte	28.00	43.40	61.40
Lebanon	35.00	.....	.....
North Manchester	31.00	39.80	.....
Richmond	27.50	.....	.....
Terre Haute	33.35	57.90	.....
Union City	37.50	60.00	.....
Iowa:			
Cherokee	33.00	49.25	.....
Sioux City	39.00	73.50	.....
Kansas:			
Emporia	22.95	42.00	.....
Louisiana:			
New Iberia	27.00	.....	38.00
Maryland:			
Hagerstown	27.00	.....	.....
Massachusetts:			
Cherry Valley and Rochdale	30.00	46.00	.....
Millbury	25.00	.....	54.50
New Bedford	31.95	54.84	59.40
Somerville	30.00	66.65	66.55
Springfield**	27.00 & 33.78	57.87	63.70
Winthrop	28.25	59.00	71.00
Woburn	27.25	50.75	60.76
Worcester	29.00	57.00	65.00
Michigan:			
Battle Creek	32.00	55.15	70.60
Belding	24.00	.....	.....
Crystal Falls	32.00	.....	63.00
Highland Park	44.25	88.00	.....
Lansing	30.00	62.36	68.06
Ludington	26.00	58.00	.....
Manistique	27.00	.....	56.60
Onoway	28.50	.....	.....
Saginaw††	30.00	62.35	74.80
Minnesota:			
Lake City¶¶	54.00	64.00	70.00
Rochester	27.-35	51.-70	52.-75
Stillwater	28.00	56.96	.....
Mississippi:			
Greenwood	.....	45.00	.....
Jackson	36.00	65.00	68.00
Montana:			
Havre	.....	58.72	64.05

PRICES PAID FOR HYDRANTS 2-WAY AND STEAMER. AVERAGES FOR 1914, 1919 AND 1920 (Continued).

City and State	Average Price Paid In 1914	1919	1920
Nebraska:			
Hastings	38.75	52.00	66.00
New Jersey:			
Bridgeton	40.00	.....	53.00
New York:			
Albany	30.75	63.65	63.65
Norwich‡‡	50.45	60.30	.....
Ogdensburg	26.50	.....	57.20
Potsdam	24.00	48.00	...
Syracuse	25.00	51.00	60.25
Watervliet	....	55.00	.....
Wellsville	22.50	.....	.....
North Carolina:			
Charlotte‡	21.50	50.25	58.50
Henderson	23.00	.....	45.00
Raleigh	25.00	37.50	59.75
Ohio:			
Barnesville	24.50	48.00	48.00
Coshocton	32.00	.....	52.00
Delaware	.....	26.65	48.55
Lakewood	24.70	59.00	58.00
Martins Ferry	.....	56.50	.....
Niles	21.00	.....	.....
Van Wert	.....	65.00	.....
Wilmington	30.00	39.00	.....
Oklahoma:			
Sapulpa	.....	58.00	.....
Oregon:			
Portland	24.90	.....	.....
Pennsylvania:			
Clearfield	22.50	.....	.....
Indiana	24.00	41.65	.....
Reading	29.00	61.10	73.25
Sewickley	25.50	34.00	36.00
Sharpsville	25.00	50.00	.....
Tennessee:			
Dyersburg	20.00	30.00	50.00
Murfreesboro‡‡	27.00	56.00	.....
Texas			
McKinney	.....	.....	55.00
Taylor	21.00	35.50	.....
Temple	36.00	67.50	92.00
Waco	29.50	61.80	67.50
Virginia:			
Charlottesville	27.50	47.50	.....
Richmond	37.50	73.50	78.50
Washington:			
Auburn	.....	.....	54.00
Spokane	54.75	102.05	.....
Wisconsin:			
Fond du Lac	24.35	67.50	.....
Janesville	.....	54.00	60.00
Oconomowoc	26.50	.....	.....
Wyoming:			
Green River and Rock Spgs.	38.21	64.62	.....

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*—With 6-inch valve. †—With 4-inch valve. ¶—4-inch. ‡—3-way. **—5-inch and 6-inch. ††—5-inch. ¶¶—2-way only. ‡‡—6-inch.

PRICES PAID FOR COAL. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price per Ton Paid In 1914	1919	1920
Alabama:			
Gadsden	$2.25	....	....
Mobile	2.95	$6.15	....
Colorado:			
Boulder	....	7.50	$7.00
Delta	6.00	7.75	8.25
Connecticut:			
Putnam	5.75	9.75	....
Delaware:			
Lewes	2.45	1.15	3.25
Wilmington	3.22	6.90	8.25
Florida:			
Pensacola	2.55	4.60	5.20
Georgia:			
Albany	1.50	3.00-3.50	4.00-5.50
Cedartown	1.10	3.60	5.25
Thomasville	3.25	6.26	6.83
Valdosta	8.30	6.00	8.40
Illinois:			
Chicago Heights	2.19	4.10	4.50
Du Quoin	.85	2.45	2.95
Mattoon	1.75	3.25	3.80
Monmouth	2.58	4.17	5.47
Quincy †	1.41	3.50	3.75
Rochelle	....	....	4.32
Rock Island	1.45	3.40	....
Waukegan	2.00	4.00	5.00
Indiana:			
Columbus City	1.25	2.40	4.15
Delphi	2.25	4.75	....
Evansville *	1.00	2.80	3.15
Garrett	....	2.20	2.45
Indiana (continued):			
Kendallville	3.85	5.06	5.59
La Porte	2.75	5.45	6.50
Lebanon	1.90	2.35	8.00
North Manchester	2.25-2.60	5.50	8.00
Richmond	.85	....	....
Shelbyville	1.15	2.00	2.65
Terre Haute	1.00	3.71	3.86
Union City	2.86	4.34	4.95
Iowa:			
Algona	6.00	7.50	10.00
Atlantic	1.80	3.90	4.00
Cherokee	2.00	....	....
Denison	2.75	....	5.10
Maquoketa	4.00	5.50	6.10
Sioux City	3.25	6.90	6.90
Kansas:			
Council Grove	....	6.00	6.00
Fort Scott *	1.10	2.80	3.10
Kentucky:			
Providence	1.80	2.75	5.30
Louisiana:			
New Iberia	3.20	5.85	5.85
Massachusetts:			
Lenox	7.50	13.00	14.00
Mansfield	....	....	4.25-4.50
Maynard	....	10.00	13.55
New Bedford	4.18	8.22	....
Springfield	7.25 L.T.	10.00N.T.	11.00N.T.
Woburn	4.86	9.18	....
Michigan:			
Battle Creek	1.20	2.75	....
Belding	2.25	....	....
Charlotte	1.10	2.15	2.50-4.00
Crystal Falls	4.50	....	9.75
Highland Park	8.75	10.50	13.00
Lansing	0.60	2.50	2.50
Ludington	4.50	6.20	7.28
Onaway	8.25	8.00	8.50
Saginaw	3.00	4.60	5.50
Minnesota:			
Hutchinson	....	10.00	10.00
Lake City	4.30	8.65	11.00
Rochester	5.00	6.00	8.00
Stillwater	3.65†	8.50-9.50¶	8.50
Mississippi:			
Canton	0.79	2.50	2.90
Greenwood	0.90	3.50	5.00
Jackson	3.45	7.10	7.85
Missouri:			
Chillicothe	1.60	3.05	3.50
Nebraska:			
Hastings	1.60	1.85	2.25
New Jersey:			
Bridgeton	3.40	4.90	5.75
New Mexico:			
Roswell	6.50	6.35	6.35
New York:			
Albany	2.43	5.25	6.25
Norwich	6.65-5.55	9.45-8.10	9.95-8.80
Ogdensburg	5.25	11.00	12.50
Potsdam	6.00	8.50	....
Wellsville	2.00	4.20	4.55
North Carolina:			
Charlotte	3.50	6.50	9.00
Henderson	3.20	5.90	7.90
Raleigh	4.00	6.96	9.00
Ohio:			
Barnesville	8.00	13.40	17.80
Coshocton ‡	0.12	0.17	0.21
Delaware	0.95	2.25	4.25
Newark	1.60	2.70	4.55
Niles	2.00	8.80	....
Van Wert	1.75	2.50	4.25
Wilmington	0.65	2.20	4.25
Oklahoma:			
Perry	1.80	4.25	4.25
Sapulpa	....	4.20	....
Pennsylvania:			
Reading **	2.70	4.50	4.95
Sharpsville	1.75	4.00	4.25
Stroudsburg	2.80	5.87	5.87
Tennessee:			
Dyersburg	1.55	2.75	3.15
Murfreesboro	2.30	5.05	5.60
Texas:			
Georgetown ††	0.75	1.40	1.75
Stamford	3.75	....	5.40
Taylor	1.22	....	2.35
Temple ††	1.58	2.58	....
Waco *	3.15	6.00	7.25
Virginia:			
Charlottesville	2.75	4.50	6.00
Washington:			
Spokane	9.12	11.65	13.75
Wisconsin:			
Fond du Lac	3.00	4.50	2.70
Janesville	....	4.05	4.85
Oconomowoc	4.10	6.23	8.88
Wyoming:			
Green River	1.25	3.57	....

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*—Slack. †—Screenings. ¶—Lump. ‡—Per Bushel. **—Bituminous. ††—Lignite.

PRICES PAID FOR ELECTRIC CURRENT FOR POWER. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Per Kw. H. Paid In		
	1914 Cents	1919 Cents	1920 Cents
Alabama:			
Gadsden	.....	.75	.75
California:			
Palo Alto	2.00	2.00	2.00
Redlands	0.98	1.23	.....
Connecticut:			
Putnam	.....	1.775	1.65
Delaware:			
Lewes	10.00	.....	.....
Wilmington	4.00	2.50	2.50
Florida:			
Pensacola	.....	2.50	2.50
Georgia:			
Albany	.875	.....	.....
Cedartown	.....	1.11	1.33
Idaho:			
Lewiston	1.50	1.50	1.50
Weiser	1.50	.....	1.50
Illinois:			
Chicago Heights	2.50	2.50	2.50
Du Quoin	1.20	2.50	2.50
Mattoon	2.25	.....	.....
Quincy	.....	.75	.75
Sparta	.....	4.00	.....
Indiana:			
Delphi	.....	2.00	3.10
La Porte	1.37	1.78	.....
Lebanon	2.50	2.50	2.50
North Manchester	.....	4.202	4.234
Iowa:			
Algona	4.00	4.00	4.00
Cherokee	2.75	2.75	2.75
Denison	3.00	3.00	3.00
Sioux City	2.00	2.50	2.50
Kansas:			
Emporia	2.00	2.25	2.25
Fredonia	2.50	2.50	2.50
Maryland:			
Hagerstown	.....	1.50	1.50
Massachusetts:			
Cohasset	.....	6.25	.....
Millbury	1.95	2.45+20%	1.95+15%
New Bedford	.....	2.156	.....
Springfield	3.00	3.00	3.00
Michigan:			
Battle Creek	1.00-1.33 1-3	1.25	1.25
Highland Park	.84	1.04	1.04
Lansing	1.14	1.80	1.80
Onaway	2.00	2.00	2.00
Saginaw	.....	.....	1.20
Minnesota:			
Cloquet	2.00	2.00	2.00
Hutchinson	13.00	12.50	12.50
Lake City	8.00	8.00	8.00
Rochester	1.50	1.50	1.50
St. Peter	.....	2.00	2.00
Stillwater	1.75	1.75	1.75
Mississippi:			
Jackson	1.50	2.50	2.50
Missouri:			
Chillicothe	2.00	2.50	2.50
Montana:			
Havre	1.16	1.16	1.16
Nebraska:			
Hastings	.....	.18	.20
New York:			
Norwich	16.00	16.00	16.00
Potsdam	3.00	.....	.....
Watervliet	.....	1.75	1.75
North Carolina:			
Charlotte	1.00	1.00	1.00
Raleigh	1.50	1.5849	1.8587
Ohio:			
Barnesville	2.00	4.00	5.00
Niles	1.00	1.00	1.00
Wilmington	4.831	3.782	3.41
Oklahoma:			
Perry	3.50	4.20	4.20
Oregon:			
Eugene	1.50	.....	9.00
Pennsylvania:			
Sharpsville	20.00	22.00	.....
South Carolina:			
Newberry	1.50	1.50	.....
Texas:			
Temple	1.60	.....	.....
Wisconsin:			
Oconomowoc	5.00	.....	.....

PRICES PAID FOR FUEL OIL. AVERAGES FOR 1914, 1919 AND 1920.

City and State	Unit	Average Price Paid In		
		1914	1919	1920
Alabama:				
Mobile	bbl.	....	....	$1.15
California:				
Redlands	bbl.	$0.70	$2.08	2.33
San Francisco	bbl.	0.80	1.80	1.80
Colorado:				
Delta		6.00	7.75	8.25
Connecticut:				
Putnam		5.75	9.75	....
Georgia:				
Albany	gal.	0.025	0.035	0.10
Indiana:				
Shelbyville	gal.	0.01	0.07	0.085
Terre Haute	engine gal.	0.143	0.246	0.29
Iowa:				
Algona		0.06	0.08-0.09	0.105
Louisiana:				
New Iberia	bbl.	1.05	1.57	3.75
Maine:				
Lisbon Falls	gal.	....	0.1225	0.19
Massachusetts:				
Cherry Valley & Rochdale		0.04	0.14	....
Cohasset	gal.	0.05 or 0.06	....	0.19
New Jersey:				
Hawthorne	gal.	0.045	....	....
New Mexico:				
Roswell		....	0.0825	0.1425
New York:				
Syracuse	gal.	0.08	0.10	0.19
Ohio:				
Barnesville	gal.	0.28	0.45	0.48
Oklahoma:				
Perry	bbl.	....	1.60	3.30
Pennsylvania:				
Strondsburg	gal.	0.03	0.10	0.15
Texas:				
Stamford	bbl.	0.92	1.15	3.00

PRICES PAID FOR LIME (for purification plants). AVERAGES FOR 1914, 1919 AND 1920.

City and State	Unit	Average Price Paid In		
		1914	1919	1920
Alabama:				
Mobile		....	$0.025	$0.025
Georgia:				
Albany	bbl.	$1.00	1.25	2.00
Illinois:				
Quincy		....	13.25	14.25
Indiana:				
Evansville	ton	8.00	12.70	14.20
Louisiana:				
New Iberia	bbl.	1.25	2.50	2.75
Michigan:				
Ludington	lb.	0.03	0.065	0.035
Mississippi:				
Jackson	ton	7.00	15.00	16.00
Missouri:				
Chillicothe		20.00	21.00	21.00
New York:				
Norwich	lb.	0.025	0.04	0.04
North Carolina:				
Charlotte	bbl.	1.00	2.00	2.25
Raleigh	lb.	0.02	0.065	0.0325
Ohio:				
Niles	ton	....	14.20	16.50
Wilmington	ton	15.00	14.90	17.00
Oklahoma:				
Perry	100 lb.	0.80	1.50	1.50
Pennsylvania:				
Indiana	ton	7.00	10.00	....
Tennessee:				
Murfreesboro	lb.	0.0225	0.07	0.09
Texas:				
Waco	sack	0.25	0.50	0.55

PRICES PAID FOR SODA ASH (for purification plants). AVERAGES FOR 1914, 1919 AND 1920.

City and State	Average Price Per Pound Paid In		
	1914	1919	1920
Georgia:			
Valdosta	.....	.....	$0.0375
New Jersey:			
Bridgeton	$0.015	$0.0285	0.0375
New Mexico:			
Roswell	0.055	0.04	0.04
North Carolina:			
Raleigh	0.025	0.035	0.033 1-3
Ohio:			
Wilmington	0.045	0.02	0.028
Pennsylvania:			
Indiana	0.00875	0.04	.....

NEWS OF THE SOCIETIES

June 16-17.—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention, Bemidj, Minn. Executive Secretary, E. L. Bennett, University of Minnesota, Minneapolis, Minn.

June 16-18—NORTH CAROLINA GOOD ROADS ASSOCIATION. Annual convention, Asheville, N. C.

June 19-21.—TRI-STATE WATER AND LIGHT ASSOCIATION. Tenth annual convention, Atlanta, Ga. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C.

June 21-23.—CANADIAN PUBLIC HEALTH ASSOCIATION. Annual meeting, Vancouver, B. C. General Secretary, R. D. Defries, M. D., Toronto, Ont.

June 21-25.—AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

June 21-25.—INTERNATIONAL ASSOCIATION OF ROTARY CLUBS. Annual convention, Atlantic City, N. J. Secretary, Chesley R. Perry, 910 South Michigan avenue, Chicago, Ill.

June 22.—JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-Treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 22-25.—AMERICAN SOCIETY FOR TESTING MATERIALS. Asbury Park, N. J. Office of secretary, Philadelphia.

June 29-July 2.—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Secretary, F. L. Hutchinson, 33 West 39th street, New York.

July 6-8.—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS OF THE STATE OF NEW YORK. Annual conference, Jamestown, N. Y. Secretary, William P. Capes, 25 Washington avenue, Albany, N. Y.

July 26-30.—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual convention, Toronto, Canada. Secretary, Stephen E. Hoey, Municipal Building, New York.

Aug. 30-Sept. 3.—AMERICAN PUBLIC HEALTH ASSOCIATION. San Francisco. Office of secretary, Boston.

Sept. 7-10.—NEW ENGLAND WATER WORKS ASSOCIATION. Annual convention, Holyoke, Mass. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Boston, Massachusetts.

Sept. 13-17.—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual convention, San Francisco, Cal.

Sept. 13-17.—SOUTHWESTERN WATER WORKS ASSOCIATION. Annual convention, St. Charles Hotel, New Orleans, La. Secretary, E. L. Fulkerson, Waco, Texas.

Oct. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 401 Lincoln Avenue, Valparaiso, Ind.

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Engineering Federation.

That the proposed organizing conference that met in Washington, D. C., June 3 and 4 to consider a plan for engineering federation will exert an important influence is assured by the appointment of delegates from about fifty of the most prominent engineering societies and clubs that represent a combined membership of more than 100,000.

American Waterworks Association.

The 40th annual convention of the American Waterworks Association will be held at the Windsor Hotel, Montreal, June 21-25. The entertainment committee, the ladies entertainment committee, the waterworks manufacturers' association, the exhibit committee and the transportation committee have collaborated to prepare a very attractive program for technical and social activities, which include a concert, a reception with dancing and refreshments, golf, shopping and sight seeing parties for the ladies, a trip through the famous Lachine Rapids, a smoking concert and cabaret, a visit to the filtration plants of the city of Montreal and to the Montreal Water & Power Company and a three days' trip to the Saguenay River and return. This trip through a region of unusual beauty offers a charming finale to the convention.

Important reports will be received from the principal standing committees: Private Fire Protection Service, Nicholas S. Hill, Jr., chairman; representatives in American Committee on Electrolysis, Alfred D. Flinn, chairman; Standard Specifications for Water Meters, Caleb M. Saville, chairman; Official Standards for Water Analysis, Jack J. Hinman, Jr., chairman; Cold Weather Troubles, Charles R. Bettes, chairman.

The general program of regular sessions will include discussions on: What Is the Proper Size of Meter for Multiple Family Houses, introduced by short papers by H. P. Bohmann, G. A. Elliott, D. W. French and W. R. Edwards; What Is the Legitimate Use of Water, introduced by short papers by A. W. Cuddeback, C. M. Saville, and W. W. Brush, and important papers on The Municipal Water Supply of Montreal, Thomas W. Lesage; The Works of the Montreal Water and Power Company, F. H. Pitcher; The Experience in Montreal in the Manufacture of Alum, James O. Meadows; The Water Works of the City of Quebec, Arthur Surveyer; Water Supply Problems in the Province of Quebec, T. J. Lafreniere; The Water Works of St. John, New Brunswick, Frank A. Barbour; Water Works Experiences, Beekman C. Little; Economic Features of Pumping Station Operation, Leonard A. Day (illustrated with lantern slides); Difficulties in Building the Louisville Pumping Station, James B. Wilson (illustrated with lantern slides); The New Water Supply of Winnipeg, James H. Fuertes and William G. Chase; President's Address, Carleton E. Davis; Testing Meters in Series, introduced by short papers by J. A. Murray, C. M. Saville and Fred B. Nelson; Experience with Compound Meters, introduced by short papers by C. M. Saville and Seth M. Van Loan; The Prevention of Water Waste on Railroads, C. R. Knowles (illustrated with lantern slides); Some Aspects of Electrolysis, Dr. Gellert Alleman (illustrated with lantern slides); The Revenue Chargeable to Public Uses of Water in the City of Rochester, Stephen B. Story; Damage to Deep Wells by Sea Water, Dr. Wm. P. Mason; Cost-Plus Contracts in Water Works Construction, G. W. Fuller; The War Burden of Water Works in the United States Continues, Leonard Metcalf.

The chemical and bacteriological section has a program devoted to the quality of water with papers on Quality of Water, George A. Johnson; Standards of Quality of Water, Jack J. Hinman, Jr.; Index Numbers and the Scoring of Water Supplies, Abel Wolman; Recent Progress in the Fight Against Typhoid Fever, W. J. Orchard; Controlling Water Purification Plants in the Province of Quebec, Mac H. McCready; The Operation of Small Water Works Plants from the Viewpoint of the Quality of the Water, Paul Hansen; Co-operative Research in Water Purification, Abel Wolman.

The principal officials of the society are: President, Carleton E. Davis, Chief, Bureau of Water, Philadelphia, Pa.; vice-president, Capt. M. L. Worrell, U. S. Army, Camp Dix, Wrightstown, N. J.; treasurer, James M. Caird, chemist and bacteriologist, Troy, N. Y., editor; John M. Goodell, 106 Lorraine avenue, Upper Montclair, N. J.; secretary, J. M. Diven, 153 W. 71st street, New York, N. Y.

City Planning Conference.

At the twelfth national conference on city planning in Cincinnati, April 19-22, Nelson P. Lewis, New York, was elected president and Flavel Shurtleff, Boston, was reelected secretary. Among the topics discussed were the importance of coordination between trunk highways and city thoroughfares; Cincinnati's Rapid Transit system and the city plan; Cincinnati's highway system and the city plan; railroad terminals and their relations to the city plans; city railroad terminal planning, and the urban auto problem.

New Appliances

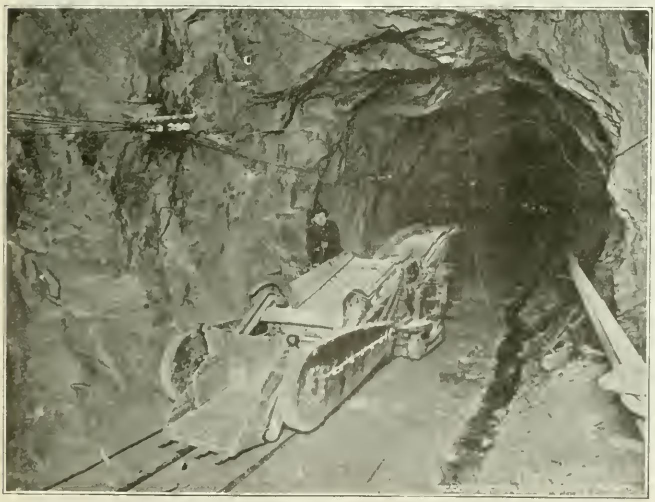
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

AUTOMATIC SHOVELING

The patent automatic mechanical shovel manufactured by the Myers-Whaley Company, is especially adapted for handling muck in tunnels and for handling shattered rock in tunnels or open trenches or to handle loose materials between stock piles, wagons and bins. It is a self-propelling machine. The No. 4 size weighs about 18,500 pounds, is from 22 to 26 feet long, 5 feet 4½ inches wide, 4 feet 9 inches high, is driven by a 20 h. p. motor or by compressed air, and has a capacity of 45 cubic feet per minute in loose materials, of which, under ordinary conditions, it loads from 200 to 300 tons in 8 hours, including movement of cars and machines. The full crew required is one operator, one car coupler, and one driver or motorman to shift the cars. It is estimated to save two-thirds of the cost of shoveling, and to consume 0.22 k. w. hours per ton of material shoveled. One machine and crew will replace from 15 to 20 hand shovelers.

The machine itself can be operated by one man, is self-propelling, forward and backward, runs on a track or may be equipped with traction wheels, will work on either straight or curved tracks or on a smooth or rough floor and will deliver material to cars immediately behind it or on either side of the track.

The shovel is actuated by a crank rotating continuously in one direction which is supported on a curved track which enables it to move downward, forward, upward and be revolved to discharge its contents onto the inclined conveyor in the rear at the rate of 13 times per minute for large machines and 18 times per minute for smaller ones.



FRONT VIEW OF SHOVEL RUN BACK FROM FACE AFTER MUCKING IN TUNNEL.

Graphic Record Supplies.

The Educational Exhibition Company catalogs special supplies chiefly for graphic records for the use of executives, sales-managers, advertising managers, draftsmen, accountants, engineers, secretaries of commercial organizations and others. Prominent items in the list are outline maps with state and county divisions and special Edexco mountings that consist of four crossed layers of cellular boards covered with a layer of cork and enclosed in oak frames, making a very light and rigid bed for the map. A full line of markers consisting of pins with colored glass heads, numbered heads, special heads, and gummed paper symbols, letters and figures that can be attached to the maps are also listed. There are also for sale drafting materials, loose-leaf chart outfits, counting machines, stop watches, swinging leaf display fixtures, and various books on statistics and graphic presentation.

The W. B. Sullivan & Sons Company, Columbus, Ohio, has issued a circular descriptive of their organization for executing in its entirety many different kinds of construction work, grouped under the general divisions of Street Grading, Pike and Roadbuilding, Asphalt Plant; Railroad Construction, Viaduct Construction, Bridge Construction; Electric Light and Power Plants, Filtration Plants, Sewage Disposal Plants; Sewer Construction, Water Line Construction, Gas Line Construction, Sidewalk Grading and Paving, General Construction Work; Cellar Excavating, General Excavating, Dredging, Foundation Walls and Retaining Walls. The circular is illustrated by numerous halftones of important work under construction including concrete reservoirs, bridges, and massive walls, steel bridge and viaduct erection, foundations and tunneling.

Sewer Pipe Joints

The use of G. K. for making joints in sewer pipes is urged by the Atlas Mineral Products Company in a pamphlet entitled Infiltration and Leakage in Sewers. This estimates that in an 8-inch sewer made with standard cement pipe joints costing 10c. per joint there will be a leakage into the sewer of 5,500,000 gallons of ground water per year per mile, the pumping of which will cost at least $55, while the increased cost of making the joints with G. K. instead of cement mortar will only be $52.80.

The joint compound is heated on the job until it is so thin so as to flow like water. In trench work, the joint is formed with the aid of asbestos runner moistened with puddled clay and clamped in position.

INDUSTRIAL NOTES.

J. B. Adams & Company's New Branches.

J. B. Adams & Company, Indianapolis, manufacturers of road building and maintenance machinery, announce that their increased business has necessitated the establishment of several branches and warehouses in the United States and

Canada that will enable them to give better service to customers and prospects.

The new branches are located at 1106 Cadiz street, Dallas, Tex., at 1000 Santa Fe street, Kansas City, Mo., and at 501 Kasota Building, Minneapolis. The establishment of these branches will facilitate the rapid filling of orders for the Adams adjustable leaning wheel graders, Adams road maintainers, road patrol scrapers, road drags, scrapers, plows and other road-building equipment.

Road Machinery Building Company Enlarged.

The Good Roads Company of Kansas City, Mo., manufacturers of high pressure atomizing road oilers, tar and asphalt spreaders, sprinklers, power flushers and other road building and maintanance machinery, was recently sold to the Good Roads Corporation, a new organization which will continue to manufacture the old line as well as other types of road machinery.

All of the active members of the new corporation have had many years of experience in the manufacture and sale of such equipment. Plans are now under way to enlarge the plants so that the production can be at least tripled. Ever since the new corporation took over the business their two experienced engineers have been studying the equipment manufactured and have made some minor improvements.

The Goods Roads Corporation is now in position to make immediate delivery of their combination high pressure atomizing road oiler, tar and asphalt spreaders and their high pressure road oilers.

An $80,000,000 Railroad Organized in Chili.

It is reported that in Santiago de Chile a corporation is being formed with a capital of $80,000,000 for the purpose of constructing a railway from Copiapo, already connected by railway with the Chilian port of Caldera, to Buenos Aires. It has also been announced that the Argentine Government has conceded to this concern ample facilities for making the necessary surveys and that the concession is at present under consideration. This railway will give a direct outlet to the Pacific for the agricultural and live stock products of the Northern Provinces of Argentina.

National Lime Association.

The next annual meeting of the National Lime Association will be held at the Hotel Astor in New York City, June 17 and 18. This meeting will be the big convocation of the lime industry for the year. The heavy demand for lime for all types of use, the critical car supply situation, and the need for constructive educational publicity touching lime, all will be actively considered by the convention.

PROBLEMS THAT CITIES ARE STUDYING WITH EXPERTS.

The city of Tulsa, Olka., has retained W. R. Holway, president of Holway Engineering Company as consulting engineer to advise in water and sewerage problems.

The Indianapolis Board of Public Works has authorized F. C. Lingenfelter, city engineer, to prepare plans for construction on the east side of White River to prevent damage from floods. The work will include a channel 650 feet wide and the elimination of two bends in the present alignment of the river and other work calculated to protect several bridges. Work will be commenced immediately and will cost about $2,000,000.

Cooper, H. L. & Company, have been appointed consulting engineers of the new hydro-electric plant and dam under construction by the U. S. Government at Muscle Shoals of the Tennessee River.

PERSONALS.

Bradbury, Bion, formerly commissioner of public works of Portland, Me., died May 16.

Johnson, W. J., contractor for canal construction, roads, sewers and grading, died recently at Utica, N. Y.

Fraim, J. B., bridge builder and formerly superintendent of erection for the Pennsylvania Steel Company, died May 9.

Foley, Timothy, a prominent railroad contractor in Canada and in the Northwest, died at St. Paul, May 25.

Alspaugh, E. L., has been appointed chief of parks for the United States Bureau of Public Roads, headquarters at Missoula, Mont.

Wallace, Frank, has been appointed resident engineer at Missoula, Mont., for the U. S. States Bureau of Public Roads.

Baker, H. S., has been appointed engineer of Spokane County, Wash.

Renshaw, C. A., civil engineer of Roundup, Mont., has been elected mayor of Roundup.

Caur, O. E., has been appointed city manager of Dubuque, Ia.

Evans, E. M., has been city engineer of Norwich N. Y.

Robertson, F. S., has been appointed general manager of the Cameron County water improvement district No. 2, with headquarters at San Benito, Tex.

Howell, D. J., has been appointed chief engineer of the Arlington District, Alexandria County, Virginia.

Collins, William, has been appointed city engineer of Decatur, Ill.

Hay, A. K., has been appointed engineer and secretary of the Ottawa, Canada, Suburban Road Commission.

Strohm, L. E., has been appointed city engineer of Kent, Wash.

Butterfield, D. T., has been appointed commissioner of public works at Utica, N. Y.

Parker, Arthur, has been appointed city engineer of Cheyenne, Wyo.

Martin, J. A., has been appointed commissioner of public works, Detroit, Mich.

Jeffries, E. H., has been appointed city engineer at Manteka, Cal.

Weymouth, F. E., has been made chief engineer of the U. S. Reclamation Service, after having served several years as chief of construction.

Sanders, C. L. B., has been elected city engineer of Gainesville, Ga.

Martin, F. A., assistant county engineer of Shawnee County, Kansas, recently died at Waukesha, Wis.

Woolf, Albert E., died in New York City, April 19. He was at the head of the Woolf Laboratories and had been prominently identified since the early attempts in the treatment of water and electrolytical treatment of water and sewage. Nearly 30 years ago he produced hypo-chloride under the name of electrozone and built a plant for its use in the treatment of the sewage at Danbury, Conn.

Martin, F. A., formerly city engineer of Webb City, Missouri, and later assistant engineer of Shawnee County, Kansas, died at Waukesha, Wisconsin, Jan. 29.

Green, Adolph, bridge contractor, of the Adolph Green Construction Company, died at Greenbay, Wis., Feb. 27.

Hamlin, Homer, of Los Angeles, who died recently, had, since he entered the city engineer's office at San Diego, Cal., in 1887, been employed on much municipal work, including the construction of the city's sewerage system, and in charge of paving, sewer and water works. He made designs for sewers, dams and tunnels and had recently been specially occupied on the compilation of reports for the United States Reclamation Service and for the Water Users Association.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

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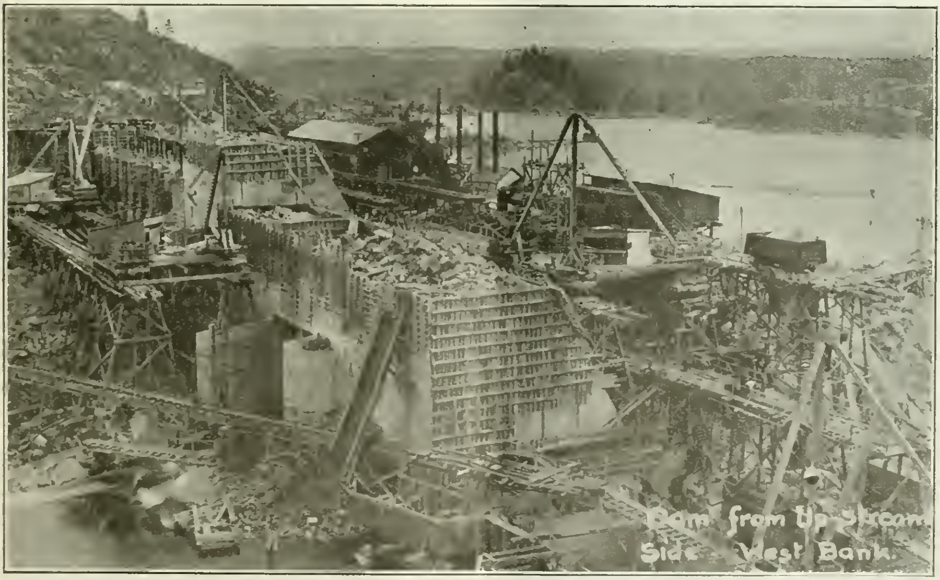
Big Eddy Storage Dam* II

Pneumatic caisson foundations forming part of main structure served also as elements of cofferdams excluding river from footings, and were built on suspended platforms and lowered to position. The mixing plant was installed on shore and 88,000 yards of concrete delivered on trestle service tracks and handled by stiffleg derricks.

The Big Eddy dam across the Spanish river at Turbine, Province of Ontario, Canada, is, as described in the previous article, a monolithic concrete structure, 1,100 feet long and 159 feet high, with a gravity cross-section about 100 feet wide at the base. It was built in swift water on an exceedingly irregular rock bottom, which had first been explored and partially levelled by submerged drilling, blasting and divers' work before commencing the main structure. This involved unusual difficulty and expense and was executed with great courage and determination and the use of some unusual expedients and executed by Fraser, Brace & Co., the contractor.

DIFFICULTIES ENCOUNTERED

The severity of the climate, the quantities of heavy ice carried in the river, and the rough and jagged rocks forming the bed of the deep, narrow river, were a few of the difficulties that were provided for by the preparation of complete plans in



UP-STREAM SIDE OF DAM, SHOWING CONCRETE FORMS, TRAVELING DERRICK ON UPSTREAM AND DOWN-STREAM TWIN TRESTLES, AND LOW-LEVEL SERVICE TRACKS.

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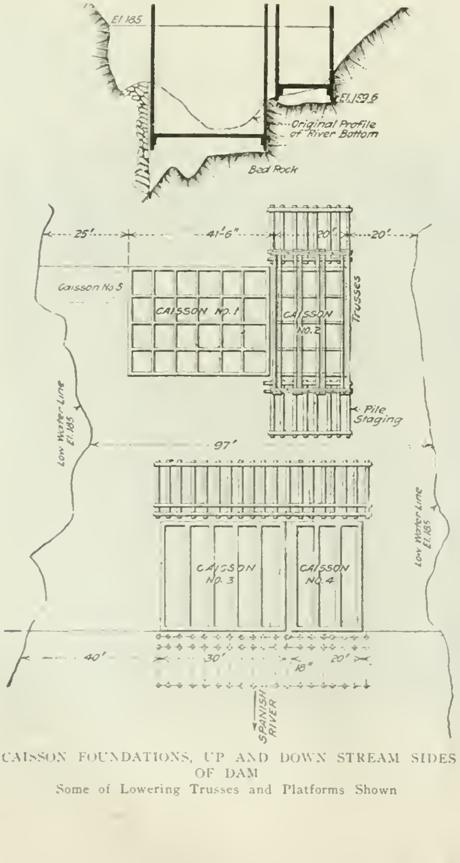
*Part I, giving general data, plan and cross-section of dam with description of location, construction of connecting railroad, building camp, installing of power plant, excavation of by-pass channel and preparation of river bottom was published in Public Works, April 17, page 319.

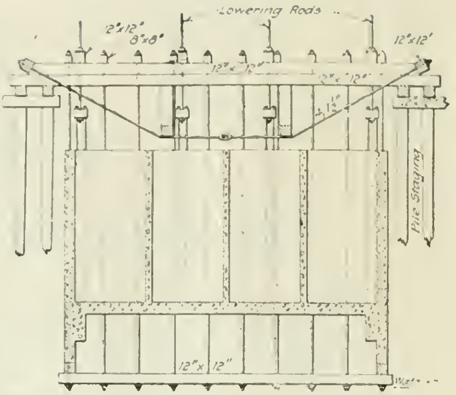
advance which were closely adhered to and successfully carried out, enabling the work to be done approximately on scheduled time, notwithstanding the many uncertainties and the development of conditions as the work progressed that could not be accurately foreseen.

The water, from 45 to 55 feet deep normally, had a low-water velocity of 4 miles per hour and the bottom, covered by 30 feet of boulders, was so hard that it could not be penetrated by piles or by ordinary excavation, and so jagged and irregular that cribs, caissons or other footings could not be fitted to it, thus making the construction of cofferdams to enclose the site a dangerous and difficult problem.

As the low-water width of the river at the dam is only from 100 to 120 feet, there was no room to build the dam in successive sections, allowing the water to flow through one portion of the original channel while construction was going on in the adjacent portion, and therefore it was built of separate units simultaneously constructed to form one continuous mass reaching from shore to shore, which was constructed within the protection of upstream and downstream cofferdams crossing the full width of the channel, the water being diverted meantime through an artificial by-pass channel previously prepared for it.



CAISSON FOUNDATIONS, UP AND DOWN STREAM SIDES OF DAM
Some of Lowering Trusses and Platforms Shown



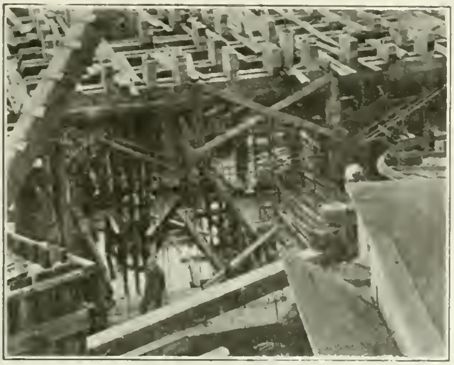
UNFINISHED CAISSON SUPPORTED ON PLATFORM SUSPENDED FROM LOWERING TRUSSES

As no ordinary form of cofferdam could be constructed or maintained in the deep, swift water of the rocky channel, it was determined to make the cofferdams consist substantially of pneumatic foundation caissons supplemented by temporary rock-filled timber cribs and sheet piling or sheeting. The penumatic caissons were located on the upstream and downstream edges of the foundation of the dam, and were designed and built in such a manner as to form part of the permanent concrete structure after they had served the purpose of excluding the flow of the river from the foundation pit.

CAISSONS

Reinforced concrete caissons from 20 to 40 feet long were therefore arranged in pairs as shown in the accompanying plan, Nos. 1, 2 (and afterwards 5) on the upstream edge, and Nos. 3 and 4 on the downstream edge. The narrow spaces between them were closed with sheet piling and, at the ends of the outer caissons, crib cofferdams were built to extend the cofferdams entirely across the channel. There was thus enclosed a space about 110 feet long between the upstream edge of the upper caisson and the parallel downstream edge of the lower caisson. This space was pumped out, enabling the bottom of the river to be prepared and concrete placed for the foundations of the dam, including and enclosing the five caissons, which were made of reinforced concrete strengthened by interior longitudinal and transverse bracing walls, dividing them into pockets which were subsequently filled solid with concrete deposited under atmospheric pressure.

The locations of the caissons were carefully sounded and platted and the bottoms were approximately levelled by drilling and blasting under water before the construction of the pneumatic caissons was commenced. As the caissons could not be launched, floated or sunk in the ordinary manner on account of the character of the bank and of the river and its bottom, they were built in position directly above their respective sites and lowered, under control, to the bottom of the river, after which air pressure was put on and they were sunk to the required depth in the ordinary manner.



CAISSON PLATFORM SUSPENDED FROM LOWERING TRUSSES

All of the caissons were built and sunk in the same manner as caisson No. 2, which in the plan is shown suspended under a set of four supporting trusses, parallel to the axis of the river, with their ends resting on pile stagings just clear of the upstream and downstream faces of the caissons. In this view the pile stagings are simply represented as timber frameworks similar to the one shown just upstream of caissons 3 and 4, and not showing the group of supporting piles under the timbers which, however, correspond with the piles shown at the downstream ends of caissons 3 and 4, where a portion of the piles and all of the timber framework are omitted. Similar stagings were provided upstream and downstream of caissons 2 and 5, but are not shown in the plan.

Each staging is composed of several six-pile bents framed and braced on shore and set in position by the 50-foot and 60-foot booms of two stiffleg derricks on each shore, which together commanded nearly all of the cofferdam area.

As the piles could not penetrate the rocky bottom, no attempt was made to drive them, but stability was secured by bracing them thoroughly in both directions to form towers, and by divers packing cement bags around their lower ends.

SUSPENDED PLATFORMS

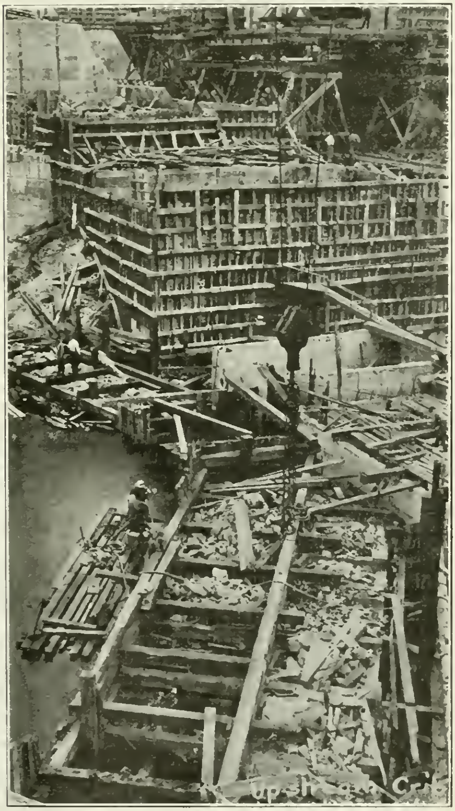
The upstream and downstream pile stagings for each caisson were connected by several double Howe trusses, each having the top chord made of two 12x12 inch full-length timbers and the bottom chord composed of four sleeve-nut connected 1½-inch diameter bent rods. Between the trusses of each pair there were placed 10 vertical 2-inch rods about 3 feet in length, with nuts and washers at both ends. The upper washers took bearing on saddle pieces seated on the top chords of the trusses, and the lower ends supported beams at water level, which beams carried a working platform on which the cutting edge of the caisson was assembled.

The exterior form, consisting of panels 8 feet high made of 2-inch planks nailed to 3-inch transverse pieces, was erected on the riveted structural steel cutting edge; and the off-set inside form was erected on the suspended platform concentric with the cutting edge. The caisson was concreted, a solid roof for the working chamber being constructed, and interior cross walls above it. The walls, about 6 feet apart in both directions, were concreted in collapsible forms with vertical joints made with removable fillers.

Pairs of 2-inch vertical rods were built into the walls of the caisson and projected above them, with nuts on the upper ends engaging yokes suspended from the lower ends of the lowering rods that passed through the top chords of the trusses and took bearing on them.

LOWERING CAISSONS

After the first course of the caisson had been concreted, completing the working chamber, the platform planks were removed, leaving the timbers in position, and the nuts on the lowering rods were turned to let the working chamber down into the water. This provided clearance under the supporting trusses for the addition of another course of forms and concrete which, in turn, were lowered, and so on, until the cutting edge took bearing on the bottom of the river; after which the tops of the caisson walls were concreted as the caissons were sunk to position by interior excavation under air



CRIBS AND CAISSONS ON UP-STREAM SIDE OF DAM

WASHING No. 3 CAISSON FOUNDATIONS WITH HOSE

pressure. The same process was followed with the other four caissons. Notwithstanding the preliminary leveling, the bottom was so irregular that, in some places, cement bags placed by divers were built up to the cutting edge and a large amount of clay was necessary for sealing the caissons. Most of the rock was very hard, but in some places it was softer.

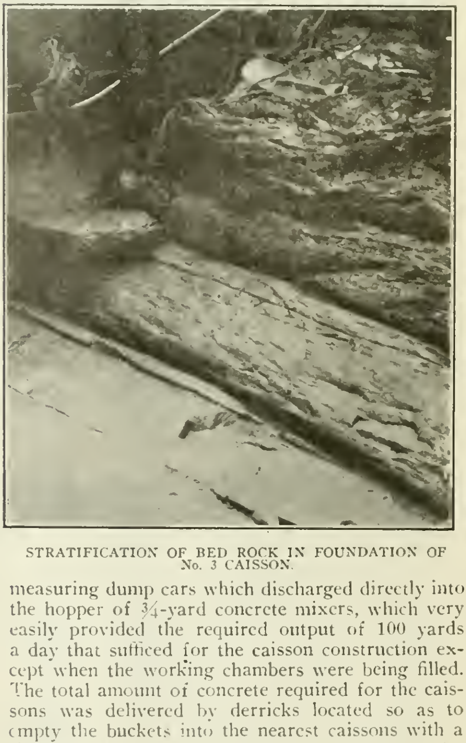
As the timber skeleton for the working platform, on which the cutting edge was erected, was not removed when the floor planks were, it afforded an excellent scaffold for men drilling and blasting the rock bottom and boulders with jackhammers and tripod drills, the steel for which in some cases had to be sharpened for every 3 inches of penetration. The adjustment of the lowering rods was facilitated by the use, at the upper end, of brass nuts bearing on well oiled steel plates, which reduced the friction sufficiently to enable them to be slacked off by two men with a long-handle wrench. Nuts at the lower ends had bearing on permanent channel saddles embedded in the concrete.

The caissons were put under air pressure on December 15, 1918, and although the temperature fell during the winter to as low as 28 degrees below zero, the season was considered a mild one for that locality, and work was prosecuted continuously and pneumatic pressure maintained until March 17, 1919, when the caisson sinking was completed. Some difficulty was experienced from the formation of frazil ice, which accumulated on the pile bents and so obstructed the channel as to form a sort of dam, raising the surface of the water on the upstream side 4 feet higher than that on the downstream side. The caisson forms were protected from cold by tarpaulins and the interiors were heated by salamanders which maintained a temperature high enough to prevent danger of the concrete freezing.

CONCRETING

The aggregate was made with sand, gravel and slag, the last being excavated about 25 miles from the dam site in a pit owned by the Nickel Company. It was drilled and blasted with black powder, which broke it into pieces with a maximum diameter of about 3 inches, which were excavated by a steam shovel that at first loaded it into standard gage Hart-Otis cars, in which it was transported to the mixer plant.

The sand and gravel were excavated in a pit about 12 miles from the dam site by a Marion No. 60 steam shovel, which delivered to dump cars similar to those carrying the slag, which deposited their contents in storage piles on the surface of the ground. From these, as required, it was loaded into measuring dump cars which discharged directly into the hopper of ¾-yard concrete mixers, which very easily provided the required output of 100 yards a day that sufficed for the caisson construction except when the working chambers were being filled. The total amount of concrete required for the caissons was delivered by derricks located so as to empty the buckets into the nearest caissons with a single movement, and into the most remote ones by two movements.



STRATIFICATION OF BED ROCK IN FOUNDATION OF No. 3 CAISSON.

CONSTRUCTION PLANT

After the completion of the caissons, the remainder of the winter, before the ice broke up in the spring of 1919, was utilized in the installation of the construction plant for mixing and handling the 78,000 additional yards of concrete required. A double-track railroad trestle was built to the mixer plant near the end of the dam on the east bank of the river, where storage was established for aggregate and cement and two 1¼-yard Ransome steam-driven mixers were installed.

The previously mentioned slag from the smelter at Copper Cliff and the sand from the pit were delivered in 35-yard Hart-Otis cars to the storage bins above the mixers. Cement in bags, which were stored in the adjacent shed, was delivered to the mixer through chutes. The gravel and slag were discharged into measuring hoppers set over the mixers, to which was added cement delivered by the chutes on signal by an electric bell. The mixers discharged the concrete into elevator buckets, in which it was hoisted and dumped into elevated hoppers just above the service track on the concrete trestle. On this track there were installed small flat cars carrying 1-yard buckets which were spotted under the hoppers and, when loaded, were hauled by a hoisting engine and cable to derricks, which unloaded the buckets from the cars and dumped their contents where required.

TRACKS AND TRAVELERS

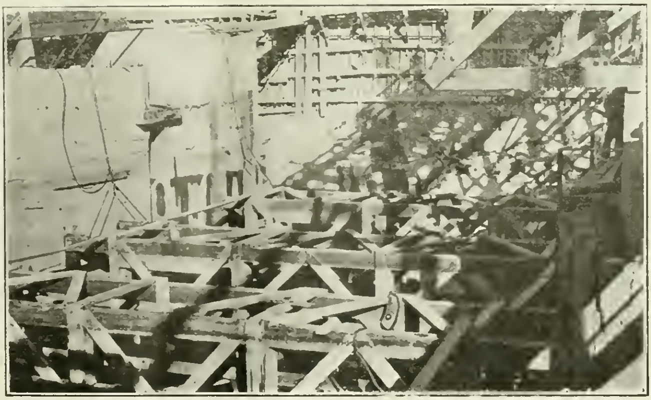
Twin trestles, parallel to the axis of the dam, were built adjacent to both the upstream and downstream faces of the dam, and on each were installed two standard-gage tracks 25 feet apart on centers. On each of these pairs of tracks there were provided two movable stiffleg wooden derrick travelers with booms 60 and 70 feet long commanding the entire area of the dam and serving to handle all of the concrete, Cyclopean stones, and excavated material as well as the forms and any part of the equipment for construction material. The elevation of these tracks was about 50 feet below the crest of the dam and about 50 feet above low water level in the river. Adjacent to the downstream trestles was a lower trestle carrying two narrow-gage tracks for the concrete cars at an elevation of 35 feet above low water. On the upstream sides of the dam another trestle carried the two narrow-gage tracks on which Cyclopean stones or plums were delivered. These delivery tracks were built on a slight grade downwards with the loaded cars and were served by hauling ropes operated by hoisting engines to pull the empty cars back to the mixer and to the storage pile.

CUTTING EDGE OF No. 1 CAISSON EXPOSED BY EXCAVATION INSIDE COFFERDAM

COFFERDAM CRIBS

As the caissons did not extend across the full width of the river, on either the upstream or downstream face of the dam, it was necessary to supplement them by cofferdams filling in the open spaces on the shore sides of caisson 3, 4, 2 and 5. These cofferdams were ordinary cribs built of square timber with rock-filled pockets. The downstream faces of the upstream cofferdams were set approximately in line with the upstream faces of the upstream caissons, and similarly the downstream cofferdams were set outside the foundation area so that, in both cases, the cribs could take bearing against the faces of the massive caissons, thus affording them support, which gave stability without requiring such large dimensions as would have been necessary if the cribs were independent structures. They were accordingly made with comparatively narrow widths, which proved adequate.

By June 15, 1919, the water in the river was low enough to permit the commencement of the cofferdam work. A full-size timber template was made and placed in the exact location of each cofferdam and soundings 2 feet apart were made from it and platted to give a profile of the bottom, to which the framing of the lower courses of the crib was made to conform. The largest crib, in water 38 feet deep on the west end of the upstream face of the dam, was 22 feet wide. At the east end, in 28 feet of water, the crib was 15 feet wide; and on the downstream side of the dam, in 38 feet of water, the cribs were 20 feet wide. The cribs were sunk to position and fitted satisfactorily on the irregular bottom. The faces were covered with sheet piling nailed on by divers, who also nailed to the bottom of the sheeting an apron of drier felt which extended outwards and rested horizontally on the river bottom and was covered by fill dumped in from above, holding it securely in position and protecting it



SYSTEM OF HORIZONTAL STRUTS, BRACED IN VERTICAL PLANES, BETWEEN UP-STREAM AND DOWN-STREAM CAISSONS

UNWATERING AND EXCAVATING

Pumping was commenced September 2, 1919, and about two days afterwards excavation was commenced between the upper and lower cofferdams where the general surface of the rock sloped from the east to the west side approximately parallel with the axis of the dam. A seal was formed on the upstream side between the caisson and the east bank. Considerable excavation was required between the upstream caisson No. 1 and the bank before solid foundation was reached and, the rock being in almost vertical strata, the working space was very small

As the cutting edge of the west side of the caisson was not sunk to solid rock, it was necessary to excavate below it and remove the loose rock to a depth of 15 feet. When this was done the exposed concrete in the working chamber was found in perfect condition and was later thoroughly bonded with the fresh conerte placed on the rock surface. However, the space between the rock and the face of the caisson was so small (only 4 feet wide at the bottom) that it was sealed with concrete placed under water through a tremie, and when after 9 days it was unwatered, it was found to be perfectly tight under a head of 20 feet.

In the construction of the two downstream caissons, No. 3 and 4, the upper parts of the upstream walls were built of timber instead of concrete above elevation 161 and 170, and after the pockets in the upper portion of the caissons had been concreted, the timber walls were removed, leaving spaces in which there were installed two 12-inch centrifugal pumps at an elevation of 22 feet below normal water level.

As the cofferdam was unwatered, heavy horizontal timber struts were set between the upstream and downstream caissons to brace them against external pressure, and when the natural surface of the river bed had been uncovered, all loose material was excavated and the sound rock was thoroughly scraped and washed with heavy hose pressure. The material excavated was shovelled by hand into 1-yard wooden skips and removed by the derricks to flat cars on the service tracks and transferred to spoil banks above the dam, where it was dumped in the river bed.

Concreting was commenced on the upstream side of the dam and the concrete was placed between bulkheads before excavation had been completed on the downstream side. The concrete in the center of the mass was a 1:3:6 mixture, and on the faces 1:2½:5 mix was used. The use of slag for concrete aggregate increased the weight from 145 pounds, which would have been produced with a rock aggregate, to 170 pounds per cubic foot.

As a precaution against uplift pressures, holes 20 feet deep were drilled every 10 feet in the river bed, pipes were inserted in them and, when the concrete had been brought up to the proper elevation, they were connected to a header carried out to the downstream face of the dam, thus affording a vent for any possible leakage.

Above the tops of the caissons the dam was built in sections with forms made of heavy wooden panels, 8 feet high, of the cantilever type, which were anchored at the lower part to the solid concrete and were strong enough to resist the horizontal pressure of the wet concrete above. These panels were handled by the derricks, which shifted them from below upwards as the work progressed. About 7,000 yards of concrete on the average was placed each month, after June, 1919. The maximum number of men empoyed at one time was about 700, of which 150 were sand hogs.

Georgia's New Road Contract

A form which the State Highway Department is intending to try out, involving an estimate by the contractor and a fee or profit varying inversely as the actual cost.

In an effort to protect the contractor and to get the work of road building more nearly in line with ordinary business methods, the Georgia Highway Department is working out a new form of contract which it is expecting to use this season. Briefly stated, the contract provides for payment to the contractor on a basis of unit costs estimated by him, to which he adds the lump sum amount which he expects to make as his profit. If the total cost of the work as constructed should be less than his estimate, the contractor will receive 25 per cent of the difference between the actual cost and his estimate of the cost, such additional payment, however, not to exceed 50 per cent of the sum originally estimated as profit. On the other hand, if the actual cost should exceed the estimated cost, 25 per cent of such excess cost will be deducted from the sum originally estimated as profit, this deduction not to exceed 50 per cent of such estimated profit; that is, no matter what the cost of the work, the contractor is sure of at least half of his estimated profit.

To illustrate the working of this system, suppose the contractor submits an estimate of actual cost of a piece of work as $100,000 and asks a fee of $10,000. Then if the actual cost of the work should prove to be $110,000, the contractor's fee would be reduced to $7,000, and if it should be $120,000 or more, the fee would be reduced to $5,000. If, on the other hand, the actual cost should prove to be only $90,000, the contractor would receive $12,500, and if the cost should be $80,000 or less he would receive $15,000 as his fee. This fixed sum spoken of as the contractor's fee is to provide for the services rendered by the contractor in providing his purchasing facilities, skill and experience, ability to organize a force, and the use of his equipment, tools etc. With the bid the contractor must submit a list of the equipment which he intends to use.

The contractor is supposed to figure out his unit costs on all the items entering into the job, such as clearing, earth excavating, concrete work, etc. The various unit costs are combined and the total is called the cost of the work. That total is the figure which the contractor tries to beat in order to get his extra compensation. Payment is to be made as the work progresses, on monthly statements on items included in the cost of the work. If, during construction, it becomes evident that changes in the specifications are necessary or that decreased or increased quantites of work must be performed, these changes will not count against the contractor when the actual cost is figured.

There is one other provision inserted for the protection of the county. Should a contractor so mismanage the work that, in order to protect the county, the State Highway Department would be forced to step in and take over the job, such power is given to the State Department. This provision seems to give the State Highway Department almost arbitrary power, but no other way was found for protecting the public. If the State Highway Department is conducted fairly and squarely, no fair and square contractor will suffer; while if the Department is not fair and square, the sooner that fact is discovered the better for all concerned.

In awarding a contract three factors are to be considered—the total amount of the bid, which is the estimated cost plus contractor's fee; second, the experience of the contractor, his financial backing and his record on other jobs; and third, his equipment. In comparing bids, the first item is given a weight of 65 per cent, the second item of 20 per cent, and the third item of 15 per cent. In considering the equipment, the size of the job will be considered and equipment which is too large and unsuitable for a small job will count no more in his favor than a plant which is too small for the job.

It is hoped by state highway engineer W. R. Neel that this plan will operate to protect the efficient contractor with a good record behind him and a good road building plant. These are the men whom Georgia wants to build her roads, and when she gets them working for her and with her she wants to protect them.

Renting Equipment to Contractors

The State Highway Commission of Montana early in May adopted a policy of renting trucks and other equipment to contractors. It was decided that only such equipment would be rented as is not otherwise requisitioned by counties, cities and towns, and that a deposit of $1,000 would be required for each truck, $1,500 for each 120 horse-power caterpillar, and for other equipment a deposit of approximately 20 per cent of its value. The rental rates were fixed as follows: For each truck $200 per month, for each 120 horse-power caterpillar $300 per month. Other equipment available for use of contractors to be rented on the basis of annual depreciation as calculated by the chief engineer.

No contractor may secure surplus war equipment until he has been awarded a contract on state work. Any equipment now being leased to contractors for use in connection with work previously contracted for may remain in their service until the completion of such contracts, after which the equipment will be subject to redistribution by the commission under the above terms.

Equipment shall be returned by contractors and at their expense to Deer Lodge on the completion of the contracts for which they were leased, or held by the contractor subject to the orders of the commission. The deposits above noted will be held by the commission as a guarantee of the safe return of the equipment in proper condition, allowing for reasonable wear. The commission will sell T. N. T. to the contractors at the rate of 15 cents a pound.

Effect of Soil on Highway Durability

The Bureau of Public Roads, Department of Agriculture, has started an investigation of the relation of soils to highway durability. Samples of soil will be taken at spots in the sub-grade of a highway where the road has begun to fail, the surrounding geological conditions being studied with a view to determining how moisture arrived in the sub-grade, laboratory tests being made to learn the physical characteristics of soils and a scientific measure being obtained for their bearing value. It is planned to cooperate as much as possible with the various state highways departments and the Bureau of Soils.

Preliminary investigation is under way on the Washington-Baltimore road and will be extended beyond Baltimore and on other Maryland roads, and a number of samples of sub-grade material have already been subjected to laboratory investigation. It is expected that important information will be secured.

The Federal Highway council has asked both national conventions to put themselves on record on the subject of national policy and plan for further highway development. The council represents hundreds of farmers and organizations interested in highway construction.

It favors the appointment of a federal highway commission to coordinate the state work and have control of the national system. It believes that the government should take over about 60,000 miles, the states 240,000 miles and the counties 300,000 miles. The continuation of federal aid to the states is urged.

For National Transcontinental Traffic

The War Department, in a report to the Highways Committee of Congress, urged the development of the highways of the country to meet the needs or transcontinental traffic, this conclusion having been reached as a result of the Army convoy of seventy-three trucks, which blazed a trail from Washington to the Pacific coast last summer.

The recommendations of the department are as follows:

First—That the necessity for a comprehensive system of National highways, including through routes east, west and south, is real and urgent as a commercial asset to further colonize and develop the sparsely settled sections of the country and as a defensive military necessity.

Second—That the existing roads and bridges, especially in the sparsely settled sections of the middle and far western states, are incapable of meeting present-day traffic requirements, and until modern types of roads and bridges are constructed, which will permit the rapid movement of heavy motor cargo vehicles during any season of the year and in all conditions of weather, economical transcontinental highway traffic will continue to be a vain hope.

Third—That the road problems of middle and far western states are national rather than local problems, as these states, while possessing vast area and tremendous mileage of highways, have only a sparse population, which cannot possibly undertake the needed highway improvement work, which, moreover, is usually of greater importance to the country as a whole than to the individual states.

Fourth—That the radius of action and resulting utility of the motor vehicle is limited only by the condition of the roads, and that the provision of adequate roads will have a far-reaching effect on the economic development of the country at large.

Fifth—That types of motor vehicles should be coordinated with road conditions, the size and weight of vehicles being limited to light and medium capacities, until all sections of the country are connected by highways passable to heavy motor vehicle traffic at all seasons of the year.

SUBWAY TO STATEN ISLAND

Transit Construction Commissioner Delaney, in a report to the Board of Estimate on the extension of the Fourth avenue subway under the Narrows to Richmond, considered six different possible tunnel routes to the island, as well as a bridge. He stated that $200,000 would be necessary to investigate the bridge project, while $50,000 would suffice for preparation of preliminary plans for either of two possible tunnels to Brooklyn to connect with the Fourth avenue subway system.

The cost of this subway extension is estimated by Mr. Delaney at from $20,000,000 to $25,000,000, but it is the quickest and cheapest way of bringing Staten Island into close touch with the rest of the city, and opening up a borough which affords room for the overflow from congested sections of the city.

Milwaukee's Activated Sludge Plant

Plans for a permanent plant for treating the sewage of the city have been tentatively agreed upon. The general features are described in this article. including those for dewatering and drying the sludge. Also some results of the five years' experiments, which have cost the city over $350,000.

The city of Milwaukee has been conducting for five years an experimental plant for studying the treatment of its sewage which is believed to be the most thorough and expensive investigation ever made by any one city in connection with sewerage or any other one municipal utility. Several articles and shorter references to this experimental plant have been published by us, chief interest being centered in its experimenting with and development of the activated sludge process. In addition to this, however, it has included in its operation experimental installations of grit chambers, fine screens, Imhoff tanks, trickling filters of various depths, colloidal slate filters, chemical precipitation, chlorination, electrolytic chlorination without lime, aeration by the draw and fill method, air applied for oxidation with mechanical mixing, reaeration of sludge, sludge drying, sludge dewatering, and numerous other minor investigations.

After about two years' experimenting, T. Chalkley Hatton and the sewerage commission of which he is chief engineer had practically decided that the activated sludge process was the one best adapted for Milwaukee conditions. Before building the five-million dollar plant, however, they employed Harrison B. Eddy as consulting engineer, who, in the latter part of 1917, recommended further investigations before final preparation of plans, and the commission rebuilt its experimental plant with a view to making more definite determination of certain points. The plant so modified was operated continuously for over a year with a fluctuation in flow of sewage corresponding to that which is expected to reach the final plant.

With this additional information Mr. Eddy recommended the activated sludge process for Milwaukee and the commission directed the chief engineer to prepare final plans and specifications to permit the earliest possible construction of the plant. The total investigation of the activated sludge process, together with the comparative operation of other processes, has cost the city more than $350,000; but this is only 7 per cent of the estimated cost of the final plant, and there can be little question that the information obtained during the investigation will be worth much more than this in securing additional effectiveness of the plant and will permit the saving of more than this in the actual cost of a plant adequate for the work.

PLANS FOR THE FINAL PLANT

The plans for the final plant have been tentatively agreed upon, and are based upon an average flow of sewage of 65,000,000 gallons per day in 1922, increasing to 129,000,000 gallons in 1950, these quantities being increased to 67,000,000 and 130,000,000 respectively for average flow including storm water, with 98,000,000 and 192,000,000 respectively as the *maximum* dry weather flows and 147,000,000 and 231,000,000 respectively as the maximum flow including storm water.

While about 90,000,000 gallons of the 1950 flow will reach the plant at a minimum elevation of 8.5, about 40,000,000 gallons at that date will reach the plant 25 feet below datum and will have to be pumped, the maximum rate of this low-level sewage being estiamted at 51,000,000 in 1922 increasing to 65,500,000 in 1950. This low-level sewage will first pass through cage screens with vertical bars spaced two inches apart. It will be lifted by three 30,000,000-gallon electrically driven centrifugal pumps automatically controlled by electrical contact from a float in the suction well, the pumps delivering the sewage into the main conduit, where it will combine with the high-level sewage, which has previously been passed through a grid screen with vertical bars spaced 3 11-16 inches apart.

The combined high level and low level sewage will then pass through a grit chamber divided into eight parallel compartments controlled by sluice gates hydraulically operated. These are so designed as to give a velocity through them of from 0.64 to 1.0 second-feet.

From the grit chamber the sewage will pass to fine screens containing slots 3-32 of an inch wide and from 2 to 2½ inches long, which are to have a capacity of passing 130,000,000 gallons per day under a 4-inch loss of head and 320,000,000 gallons of combined dry-weather and storm flow under a 12-inch loss of head. The screenings are to be removed by brushes and delivered upon a belt conveyor.

From here the sewage will pass into and through aerating tanks which will be approximately 340 feet long, 22 feet wide and 15 feet effective depth. Extending across each tank at right angles to the flow will be gutters, space 4.5 feet between centers, in the bottoms of which gutters will be filtros plates. In these aerating tanks, activated sludge will be mixed with the raw sewage and the two aerated together, after which the aerated mixture will flow through conduits into sedimentation tanks 75 feet square on top, 72 feet on the bottom and 15 feet in effective depth. Each tank will have a bottom slope of approximately 18 inches and will be equipped with a Dorr thickener or similar device for removing the precipitated sludge continuously to a central outlet in the bottom. The velocity of flow through the sedimentation tanks is not to exceed 1.5 feet per minute.

The effluent from the sedimentation tanks will flow over weirs into the outlet, which will discharge it into the lake near the harbor entrance, where the water has a depth of 14 feet.

The sludge is forced out of the sedimentation tanks by the hydraulic head and flows through an open conduit, through the bottom of which air is admitted to keep the sludge in suspension and prevent it from settling in the conduit. Part of this sludge is sent to the filter presses and the remainder is returned to the aerating tanks, both parts being delivered by pumps. Under normal conditions 18 per cent of the activated sludge will be returned to the aerating tanks, but this can be greatly increased without interfering with the process. During Sundays and holidays, when the sludge presses and drying plants will be shut down, all the sludge, estimated to amount to 12,000 gallons per million gallons of sewage, will be returned to the tanks.

The sludge which is not returned to the aerating tanks will have sulphuric acid added to it at an average rate of 4.5 c.c. per gallon of sludge to facilitate the dehydrating of it. A stuff pump will force the acidulated sludge into filter presses, where it will be reduced to a water content of 80 to 85 per cent., the water expelled by the press flowing back into the low-level sewage, to again pass through the plant. This sludge is mixed with the screenings from both the fine screns and the coarse screens, the former having first had their water content reduced to from 80 to 85 per cent by passing them through still rolls, and the coarse screenings having been passed through a press of the cider-press type. The mixture of screenings and sludge cakes will be carried to driers by a grab bucket operated by an electric hoist. The driers will be of the continuous, revolving, and either direct or direct-indirect type, 60 feet long by 82 inches in diameter, each guaranteed to be capable of reducing the moisture of one ton of sludge per hour from 85 per cent to 10 per cent with a fuel combustion of one pound for each 8 pounds of water evaporated.

The sludge and screenings, reduced to 10 per cent moisture content, will then be screened through a shaker screen having 10 meshes to the inch, the matter which fails to pass the screen being ground and rescreened. The matter passing the screen will be ready for sale and will be conveyed to storage hoppers which will have a capacity of ten days' output. These hoppers will deliver their contents into bags, being arranged for automatically delivering a fixed amount into each bag and recording the number and weight of the bags filled. The bags will then be carried by a bag conveyor to a car-loading platform or a storehouse.

The grit settling in the grit chamber will be removed by a clam-shell bucket suspended from the end of a 50-foot boom operated by a ten-ton locomotive crane and will be deposited back of the bulkheads along the dock line for filling in low land adjacent to the plant. The grit chambers are protected from being damaged by the bucket by a floor of steel rails 15 inches apart and ½ inch above the concrete bottom.

It is estimated that the coarse screenings collected will amount to 0.022 cubic yard, or 0.02 ton per million gallons of sewage; that the grit will amount to 2.3 cubic feet per million gallons; the fine screening 618 pounds at 87.2 per cent moisture; the excess sludge, 12,100 gallons at 97.5 per cent moisture, or 102,850 pounds, with a specific gravity of 1.02; sludge cake, 10,083 pounds at 80.3 per cent moisture; and dried sludge, 2,521 pounds at 10 per cent moisture.

It is planned to provide 1.5 cubic feet of air per gallon of sewage, based on the average dry-weather flow, which includes the air applied at all points. The pressure of the air will average 7 pounds.

The power necessary for operating this plant is estimated at 11,835 horse power for the 1950 volume of flow, which is being divided into 805 horse power for operating the low-level centrifugal pumps, 10,057 horse-power for the blowers for compressing air and auxiliaries, and 973 horse power for the generators for operating miscellaneous motors for all purposes connected with the plant.

ESTIMATED COST

Estimating the cost of any plant to be built during the next three or four years is difficult if not impossible with any confidence as to its accuracy, but Mr. Hatton estimates the cost of a plant with a capacity of 85,000,000 gallons adequate for the year 1930 at $5,000,000. This total, however, includes considerable provision for extension of the plant to meet the 1950 volume of flow; 17 of the 22 acres covered by the plant must be recovered from the lake at a cost of more than half a million dollars; all structures must be supported upon pile foundations using 25-foot to 40-foot piles driven on 4-foot centers, and the materials and labor have to be estimated at 80 to 100 per cent more than pre-war costs.

The annual cost is estimated to be $33.58 per million gallons of sewage treated, $14.07 of which is capital charges and $19.51 is operating costs. The latter are based on paying labor $4 a day, 0.75 cents per k.w.h. for electric current, $4.75 per net ton for coal, 20 cents each for burlap filter bags, and 1 cent per pound for sulphuric acid.

On the basis of the experiments it is estimated that one ton of dried sludge will be obtained per million gallons of sewage and that the sludge will contain an average of 4.5 per cent nitrogen as ammonia, worth $4 per unit. This estimate is believed to be conservative, since the sewage treated in the demonstration plant has produced 1¼ tons of dried sludge per million gallons and has contained about 5.5 per cent of nitrogen as ammonia, and the present quotation is now $6.50 instead of $4 per unit. This estimate of returns would give $18 per ton, or per million gallons, which is $1.51 less than the operating cost or $15.58 less than the total cost. This net cost is considered by Mr. Hatton to compare favorably with that of any other type of treatment producing a comparable effluent.

RESULTS OF TEST

A great deal of valuable information will be given to the engineering profession when the results of this long and thorough investigation are made public, as we presume they will be. Special investigations were made of screens, sedimentation tanks, methods of de-watering and drying sludge, and scores of minor points.

In connection with the screens, tests with band screens containing 1/8-inch slots and others containing 3-32-inch slots show that the 1/8-inch slots would pass about 20 per cent more sewage than the narrower ones, but collected 30 per cent less screenings. The effluent from the finer screen could be treated at a higher rate per acre, which would thus reduce the cost for aeration tanks. Undoubtedly a still finer slot would have increased the amount of screenings removed, but it was found that the sludge obtained from sewage which had passed through screens finer than 3-32-inch did not contain sufficient coarse matter to permit de-watering the sludge readily, it being found that sludge should contain coarse matters, hair, etc., to afford vehicles by which the water could be led from the interior of the sludge cake to the outer surface.

Aerating tanks 10 feet deep and others 15 feet deep were experimented with, and it was found that the latter gave somewhat better results in addition to requiring less area of plant.

During four months the same sewage was run through two tanks, one having one square foot of filtros plate area to 4.4 square feet of tank and the other one square foot to 6 square feet of tank area. The former gave so much better results that the ratio of 1 to 4.5 was adopted.

Investigations of sedimentation tanks conclusively indicated that satisfactory sedimentation could be effected at the rate of 1,800 to 2,000 gallons per square foot of tank area; also that the minimum depth should be 15 feet when treating ordinary fluctuating flow, since the fluctuation caused the fine sludge zone to rise from 2 feet during low flow to 13 feet during maximum flow; and that the flowing-through velocity should not exceed 1.5 feet per minute.

It was found that the sludge should be given at least an hour's time for settling. If removed as fast as it accumulated it would have a moisture content of 99 or 99.5 per cent, whereas after an hour or more of settling this would be reduced to 98 per cent, or to from one-half to one-quarter the quantity. This was effected in the test plant by the use of a plow or scraper which forced the sludge to a central opening in the bottom of the tank, but which allowed the two or three feet of sludge above the plow to remain in the tank. To secure this result it was found that the speed of the plow should not exceed 13 feet at any point.

One of the most difficult problems was and may continue to be the de-watering and drying of the sludge. Three types of press and two types of centrifuges were experimented with, together with numerous details as to filter cloths, feeding devices, etc. No success whatever was obtained with centrifuges, and the best results were obtained with the plate press made by the Simplex Company of Chicago, and the platen press made by the Worthington Pump and Machinery Company of New York and known as the Berrigan press. Experiments are still being conducted with a type of filter plate made by the John Johnson Company of Brooklyn, N. Y., and with the one used in the sewage disposal plant at Worcester, Mass.

In order to prevent nuisance by the odors arising from the drying of the sludge, it is proposed to install a method tried out at the experiment station, by which the gases are drawn through a dust chamber and thence through a spray washer, the water containing soluble gases being discharged into the low-level sewage.

The Florida state road department is making tests of available materials and mixtures to determine the most advantageous design for concrete pavements that will be laid over 1,700 miles of highway there.

Pneumatic Caisson Tunnel Shafts

Steel concrete 34x62-foot double shafts sunk 80 feet for installation of eight shields for excavating tunnels under East River at 14th street, New York. Walls built and sunk in successive operations. Roof of working chamber three times placed and removed.

Section 3 of the 14th Street-Eastern Subway for the Rapid-Transit System of New York City, consists of a pair of twin tube tunnels, about 12 feet apart in the clear, that cross under the East river from 14th Street, Manhattan, to Brooklyn. Each tube has a segmental cast-iron shell lined with concrete with a clear inside diameter of 15 feet or 15 feet 6 inches.

The tunnels were driven by the pneumatic process by means of eight excavating shields, four of which were installed at the foot of a shaft near the bulkhead line on the Manhattan side of the river, and the other four from the foot of a similar shaft near the bulkhead line on the Brooklyn side of the river.

These shafts were substantially duplicates, and each consisted of a rectangular 34 x 62-foot steel box 80 feet deep from a few feet below the surface of the ground to below the tunnel invert, and divided into two equal symmetrical wells by a center transverse wall.

All of the walls consist of an inner and outer skin of steel face plates 5 feet apart connected by systems of stiffener trusses and girders, and all of the walls are filled solid with concrete. In the outer walls the vertical external plates extend to the steel cutting edge riveted to them and to internal face plates that, at the lower part, form an inclined surface intersecting the horizontal roof of the working chamber 7 feet above the cutting edge, above which the inner face plates are vertical and parallel to the outer plates. The transverse partition wall, however, extends only a short distance below the roof of the working chamber, leaving the latter entirely unobstructed over the full area of the caisson.

Besides being used for construction purposes and for the handling of materials in and out of the tunnels, the shafts will, after the completion of the tunnels, remain in service as permanent ventilating shafts and for emergency exits and will eventually be supplied with forced draft ventilating equipment for use in emergencies.

The shafts were built and sunk as a part of the general tunnel contract, which was awarded to Booth & Flinn, Ltd., in February, 1916, on a unit price basis which it has been estimated will bring the final cost to the city to about $6,500,000.

ERECTION OF CAISSONS.

Operations were commenced at about the same time on both sides of the river by the excavation of pits slightly larger than the lateral dimensions of the caissons, that were carried down to about ground water level, a depth of about 10 feet below the surface of the Manhattan side where slight pumping was necessary, and to a depth of 5 feet on the Brooklyn side. Each site was commanded by a pair of wooden stiffleg derricks with 60-foot booms, each of which operated a 1-yard clamshell bucket with which the earth was removed.

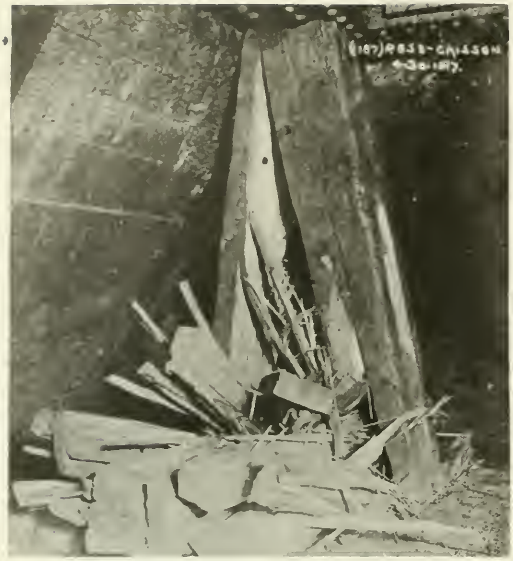
In the bottom of each pit the cutting edge was assembled and on it the walls were erected, the inner wall being, for convenience, supported on vertical shores or pump logs about 6 feet apart on centers, that were provided with 4-inch jackscrews at the lower ends bearing on 12 x 12-inch timber sills wedged up on transverse beams laid in the bottom of the pit, and thus providing for the direct support of the steel work independent of the sloping inner wall of the working chamber and also furnishing a convenient method for adjustment and the correction of settlement.

The steel, fabricated at the Ambridge plant of the American Bridge Company, was delivered by lighters and was assembled by the two booms of the derrick tower shown in the illustration.

In the first operation, the walls were carried up to about one-third of their final height, and on the east and west sides of the caisson, just above the cutting edge, there were provided four circular steel bulkheads of a diameter 2 feet greater than the external diameters of the tunnels. These bulkheads were practically sections of the regular outer walls made with special beams and stiffening trusses connecting the inner and outer plates, and bolted, instead of riveted, to the main walls to provide for their easy removal. All the rest of the assembled pieces were riveted in position, and the seams were calked with pneumatic tools as fast as the work progressed. The calking tools and riveting hammers were operated with compressed air furnished by the plant installed for the pneumatic tunnel work.

CAISSON SINKING.

The work was carried on with an average force of about 100 men, and as soon as the caisson on one side of the river had been built up to a given height, the steel men were transferred to the opposite shore to work on the caisson there, while the caisson they had just left was sunk by interior excavation under air pressure. By the time the second caisson was built one-third of its height, the sinking of the first one had progressed a corresponding amount and the roughnecks and sand hogs were shifted, each replacing the other, and a new section of steel was built on the first caisson while the second was lowered, and so on, alternating until



SHORE CRUSHED BY SETTLEMENT OF CAISSON

both caissons were sunk to the required depth of about 80 feet, the work being commenced in December, 1916, and finished in April, 1917.

Most of the material was excavated by hand, loaded in buckets and hoisted through the air shafts and muck locks by the booms of the derrick towers, which swung loaded buckets over the tops of the caisson walls and emptied them into hopper bottom elevated storage bins from which the muck was easily delivered to trucks that disposed of it. A small portion of the material, especially on the Brooklyn side, was mud which was ejected from the working chambers through the blow-off pipes.

SKIN FRICTION.

As the caissons descended and the skin friction on the exterior increased, it was necessary to add to their weight in order to keep them in motion and water ballast was accordingly pumped into the walls above the working chamber as required and was supplemented by cast-iron weights.

Although the caissons were nominally duplicates, considerable difference was experienced in sinking them, and that on the Manhattan side, which was sunk 2 feet deeper than the Brooklyn caisson, required a total weight of about 7,428 tons, composed of 1,700 tons of caisson steel, 1,600 tons of concrete, 600 tons of water ballast and 1,528 tons of cast-iron ballast. The Brooklyn caisson required, on the contrary, a total of only 6,445 tons, composed of 930 tons of caisson steel, 4,650 tons of concrete, 150 tons of water ballast and 715 tons of cast-iron ballast. This discrepancy is probably accounted for by the difference in the soil and by the fact that rock was encountered by the Manhattan caisson and not by the Brooklyn caisson and that the passage through the rock was easier than that through the earth. Some advantage was derived from the use of water ballast on account of its convenient loading and unloading, and because it provided a uniformly distributed load on the top of the working chamber roof to balance the pneumatic pressure on the lower side. The most rapid progress made was sinking 4 feet 8 inches in 24 hours for the Manhattan caisson.

CAISSON PRESSURES.

The highest pressures involved were 39½ pounds per square inch above atmospheric in the Manhattan caisson and 22 pounds in the Brooklyn caisson, both of which were developed during the sealing of the working chamber.

In accordance with the strict requirements of the New York State law, the length of the shifts for the sand hogs varied from 8 hours for pressures of 22 pounds or under to 6 hours for pressures of 22 to 30 pounds, 4 hours for 30 to 35 pounds, and 3 hours from 35 to 40 pounds. These shifts were, however, divided into two working periods, the longest being 5 hours for the lowest pressure, and the shortest being 1½ hours for the highest pressure, with an interval of at least 3 hours for rest and decompression between shifts. When the pressure exceeded 35 pounds, the work was

GENERAL VIEW OF CAISSON AT FOURTEENTH ST. AND AVENUE D, MANHATTAN, FOR SUBWAY TUNNEL CONSTRUCTION carried on by 8 shifts, each consisting of two 1½-hour periods. Great care was taken to prevent too rapid decompression when the men emerged from the caissons, and no serious cases of the bends were developed. The contractors, however, maintained on each side of the river a hospital air lock, physician, and attendants.

The legal requirements for decompression are that the time in minutes shall be twice the pressure in pounds, divided by 3, until the pressure reaches 36 pounds, and that for each additional pound over 36 pounds, 1 minute shall be added.

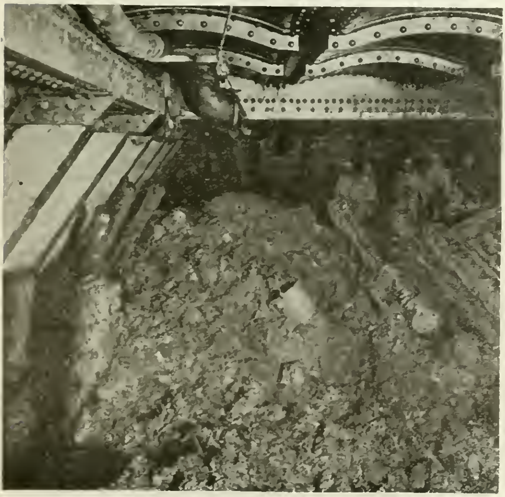
The positions of the caissons were carefully located and little difficulty was encountered in sinking them accurately. When the Manhattan caisson had nearly reached its final position, the roof of the working chamber was shored up at one point to correct a little too rapid settlement there and the heavy pressure caused one of the vertical timber supports to be crushed, as shown in the accompanying illustration, but no damage resulted and there was no material displacement of the caissons.

At each caisson there was installed a 1-yard concrete mixer delivering to steel buckets that were handled by the booms of the derrick tower, and dumped into distributing hoppers from which short wooden chutes conveyed the concrete to the required positions in the walls.

After the caissons were sunk and the bottoms satisfactorily prepared, the working chambers were concreted under air pressure to a minimum thickness of 5 feet at the center of each compartment forming heavy floor slabs, horizontal on the bottom, and with the upper surface making groined arches 7 feet thick under the outer walls of the caisson and under the transverse partition wall, which was given bearing on the concrete slab.

INSTALLATION OF TUNNEL SHIELDS.

After the bottoms of the caissons had been concreted, the roofs of the working chambers were separated into 6 x 3 foot panels of buckle plates and the girders were detached and removed. Wooden cradles were then provided on the concrete bottom and on them were erected in each well of the shaft a steel shield 18 feet 5½ inches in diameter, 15 feet 3¾ inches long, with a skin 2 inches thick and weighing altogether 104 tons. After the shields were completed the roofs of the working chambers were reassembled and connected to the walls of the caisson about 25 feet apart above their original position, clearing the shields, and pneumatic pressure was re-established under the roof.


OLD CRIB TIMBERS ENCOUNTERED IN WORKING CHAMBER

INNER WALL OF CAISSON ADJUSTABLY SUPPORTED DURING ERECTION

The circular bulkheads opposite the forward ends of the shields were then carefully removed and the shields were driven through the openings thus provided by the operation of seventeen 8-inch hydraulic jacks of 125 tons capacity operating on each shield and reacting against a special framework built to receive them on the opposite caisson wall. In each case the two shields in the foot of the same caisson were started in opposite directions, one toward the river and the other toward the shore. The air pressure of between 30 and 40 pounds was maintained in the bottom of the shaft until the shields had advanced about 150 feet, when air locks were built in the completed portions of the tunnels in the rear of the shields, permitting the air pressure to be maintained at the shields and released in the foot of the shafts.

The working chamber roofs were again removed in the shafts and the second pairs of shields were constructed in the bottoms of the shafts, headed in the opposite directions to those first constructed, the roof again replaced and air pressure re-established, the remaining circular bulkheads removed, and the last four shields driven through the sides of the shafts and into the ground beyond, as already described. When they were sufficiently advanced, air locks were built in the completed tunnels behind them, the pressure released in the foot of the shaft and the working chamber roofs again and permanently removed.

The shields were built by the American Bridge Company, and about 6 weeks was required to get each set of them assembled, riveted and started on its excavation.

The work was done under the direction of Chief Engineer L. Turner, Tunnel Engineer C. M. Holland, Resident Engineer William McK. Griffen, and Superintendent Michael Quinn.

A Platform For American Industry

A statement of principles urged by the National Association of Manufacturers for adoption by the National Political Parties.

At the New York twenty-fifth convention Ma. 18 of the National Association of Manufacturers there was adopted a "Platform for American Industry," to be submitted to the Republican and Democratic conventions for incorporating in thei: national platforms.

It calls for the liberation of American industry from the "many obstacles now created by unnecessary regulation," and is intended also as a challenge to the American Federation of Labor. In presenting its platform the Manufacturers' Association calls upon the people to choose between its platform and the principles of the federation.

The principal planks include Industrial Bargaining, Immigration, Government Ownership, and Regulation of Combinations. Special attention was called to public feeling against union methods:

> The passage of the Adamson act by the intimidation of Congress was the turning point in the alienation of public sympathy for unionism. The loss of the steel, coal and police strikes and the failure of Congress to put plums in the Plumb pudding is still further evidence of dislike. The public should, and it is believed can, be made to realize that nothing but a united effort of all our citizens for thrift and greater industry can prevent a financial crisis. This applies to all employes.
>
> The right to strike or lockout, which is merely an exercise of the right to act in combination, must be defined and limited wherever it conflicts with the community's paramount right of self-preservation. It is therefore essential:
>
> 1. That the national and state governments, each in their respective fields, shall assert and establish effective control over combinations operating in production and transportation essential to the life of the community.
>
> 2. The public interest requires that the possession and exercise of power through combination shall be accompanied by corresponding responsibility. Every association, whether of employers or employees, must be equally subject to public authority and legally answerable for its own conduct and that of its agents.
>
> 3. The life of government is its power to function. The right of government employes to adequate hearing and just and generous treatment must be amply protected, but the right of such employes to combine to stop or obstruct the operation of government does not exist.
>
> 4. The paramount common interest in continuous public utility service empowers and obligates the government to control all combination to paralyze or obstruct it and requires the ultimate submission of disputes threatening the interruption of such service to impartial adjudication without depriving the community of it
>
> 5. To preserve equality before the law, the same principles of conduct must apply to all classes of citizens under like circumstances. To make or propose to make it right and lawful for one class of citizens to do that which is unlawful or crimnial when done by another class, or to prohibit or pretend to prohibit the use of public funds to enforce any law against an excepted group of possible offenders, is vicious. It should be condemned in principle and offending enactments repealed.

The platform urges readjustment of railroad rates "to save the country from irreparable injury." Compulsory arbitration is advocated to prevent railroad strikes.

"A constructive policy of selective immigration" is urged for the purpose of replenishing the country's labor supply. The general prohibition of immigration is branded as "a counsel of bigotry and selfishness." Careful examination of all prospective immigrants, both abroad and upon entering the country, is urged, as well as a constructive program of distribution of immigrants and their Americanization.

An attack upon the American Federation of Labor on the ground that many of its policies are "inimical to the public good" was made in the report of the committee on industrial betterment and safety, which was adopted and ordered incorporated in the record of the convention.

Union labor has defiantly challanged all opponents to its ambitions in the coming elections.

Many of the leaders of organized labor, the report asserts, urge violence as a means of settling industrial disputes. The entire federation is arraigned on its principles, and the report concludes that it is impossible for leaders of industry to cooperate with union officials because of the alleged stubborn and dogmatic stand taken by them.

The report demands the incorporation of unions so that they may be held to the same responsibility as industrial and financial corporations.

"The union policy of equal compensation for classes, regardless of individual ability, under the guise of common brotherhood and the restriction of output," the report says, "is a blight on the membership, destructive to loyalty, deteriorating to capacity and creative of dishonesty, dissatisfaction and unhappiness."

The desperate need of housing in New York City needs no emphasis to be understood. Yet when Mayor Hylan recently proposed to raise $100,000,000 for building new residences and asked for cooperation by capital and labor, union labor responded by requiring $1.25 an hour and the destruction of all partially completed non-union construction before union reconstruction would be commenced.

The destruction of perfectly good completed work to induce union labor to reconstruct is an act of imbecility and a financial crime that should be made legally punishable.

It must be apparent that the interests of employers and union officials are absolutely incompatible and that further effort to cooperate with these officials is not only impossible, but unwelcome to them.

What this country now needs is one of our war drives—a national campaign for industriousness, thrift and common sense. A work slacker is no better than a soldier slacker.

An honest day's pay for an honest day's work, and an honest day's work for an honest day's pay, is the simplest and best platform for employer, employe and the public alike.

Portland Building Zone Ordinance

This ordinance has been adopted by the City Planning Commission, and will be submitted to the voters in November, calling for eight kinds of Use Districts, and six of Height-of-Buildings Districts. Comments from other cities are added.

The matter of city planning has been under consideration for some time in Portland, Oregon, and the results of the work of the commission in planning street lay-outs were described at some length in Municipal Journal and Public Works for August 23 and 30, 1919. Along the same progressive lines has been the work of the City Planning Commission in preparing a building zone ordinance, which was finally adopted on March 17 of this year and will be voted upon at the general election next November.

As in the case of the street planning work of the commission, tentative regulations of a proposed building zone ordinance and lay-out of zones of different classes were prepared by the commission and then presented before meetings of property owners of the various sections of the city, more than 150 of such neighborhood meetings and conferences having been held. A representative committee of property owners in each neighborhood combined with the City Planning Commission to evolve a preliminary zoning plan, which was later ratified at a neighborhood meeting to which all property owners of the district were invited. These neighborhood plans were later pieced together to make up the general preliminary zoning plan for the city.

As finally reported to the City Council, the zoning ordinance provides for eight kinds of "Use Districts" and six classes of "Height-of-Buildings Districts."

Of the Use Districts, Class 1 is for single-family dwellings, churches and schools only. At present approximately 86 per cent of all the buildings in Portland are single family dwellings, and two-thirds of the area of the whole city is set aside for Class 1 districts.

Class 2 are residence districts in which any kind of flats, hotels or apartments are permitted. Buildings of this type actually cover today an aggregate of about 250 blocks, and the ordinance provides for 1,250 blocks of this class, besides permitting this type of building in more than 800 additional blocks of Classes 3 and 5. These districts are generally established around the central core of the city, and in numerous small districts throughout the outlying sections.

Class 3 is for all ordinary stores, trades and professions, including any of the dwellings of Classes 1 and 2. This class was to cover the downtown retail center and a number of such centers which desired to keep out the public garage and other businesses which interfere with the best retail store development.

Class 4 is for public and semi-public buildings, schools, churches, playgrounds in parks, airplane landing fields, libraries, fire-houses, green-houses, etc.

Class 5 permits any kind of new retail or wholesale business, warehouses, public garages, dyeing and cleaning establishments, undertaking parlors, etc. This class will be located surrounding the downtown retail center, and at practically all existing local business centers at cross-roads, about every half-mile conveniently located throughout the outlying residence districts.

Class 6 is for hospitals, sanitariums, clinics, day nurseries, homes for the aged or children, and other charitable institutions. In a few cases where good home neighborhoods have been invaded by such institutions and property owners have vigorously protested against making them permanent, they will either have to seek a new location or convince their neighborhoods before they can be enlarged.

Class 7 is for all ordinary but not obnoxious industries, warehouses and factories, but excluding new residences of any kind. These districts will include approximately 6,000 acres within the city limits. The exclusion of residences from these districts is similar to the practice adopted for Alameda and Newark.

The Height-of-Buildings Districts are divided into 2½-story, 3-story, 4-story, 6-story, 8-story and 10-story districts. A few buildings of 14 and 15 stories already exist in the central downtown retail district, which is made a 10-story district, but the assessor and owners of property testified that these high buildings were not profitable and were objectionable as cutting off light and air from their neighbors. As in other cities, towers, gables, grain elevators, etc., can exceed the high limit, provided they set back one foot for each additional foot of height above the height limit and do not cover more than 2,500 square feet on the base area.

It is provided in addition provided that in Class 1 new dwellings can cover not more than 40 per cent of the area of the lot at grade nor more than 30 per cent above a level 16 feet above grade. Practically all the homes of these districts at present cover only 20 to 25 per cent of their lots.

ZONING IN OTHER CITIES.

During discussions of the zoning ordinance before the City Council, it was thought desirable to determine how similar ordinances had worked in other cities. Mayor George L. Baker wired the mayors and realty boards of a number of principal cities, asking their opinions on this point.

The mayor of Oakland, where a zoning ordinance has been in effect since April, 1919, reported "Results satisfactory to everyone." The city clerk of Los Angeles—"Working satisfactorily." Los Angeles Realty Board—"This board favorable to building zone regulations and believes them advisable." Henry W. Kiel, mayor of St. Louis—"It has protected residential districts from invasion of inappropriate structures, and seems to have general approval." J. H. Farish, president, St. Louis Real Estate Exchange—"The zoning regulations adopted two years ago are not popular with many real estate agents since they prevent the indiscriminate sale of vacant lots for every use. They have considerable merit in that they prevent the invasion of apartments or business buildings in residential districts. I am not of the opinion that they stabilize values or help conditions."

Charles E. Hewes, city manager of Alameda, Cal.—"Zoning ordinance in effect just one year. Already we see beneficial results, especially in regard to protection of homes and houses—general satisfaction expressed throughout the city." H. U. Nelson, secretary, Minneapolis Realty Estate Board—"Minneapolis Realty Estate Board is a unit in believing that zoning conserves real estate values and promotes an economical and logical growth. We are trying to obtain a zoning plan for Minneapolis. Minneapolis is going to have a comprehensive zoning plan if it has to elect an entirely new City Council to get it."

A. W. Stanmeyer, president Cook County Real Estate Board—"Common Council of Chicago today unanimously approved building zoning ordinance proposed by this board." (Sent February 18, 1920). Richard O. Chittick, executive secretary, Real Estate Board of New York—"Majority public sentiment here approves zoning plan and general effect is undoubted stabilization of values and rents."

Planning Houston's Port

Whereas, most American ports have grown without any definite plans and are consequently in many respects inadequate to accommodate the increase in traffic, those in charge of the development of the Port of Houston intend to build with an eye to the future.

A definite plan has been worked out within the last year. The sharp curves in the inland channel are to be reduced, and the radius of curves increased from 2,500 to 3,000 feet. It is planned to build turning basins at several points along the inland portion of the channel. The establishment of harbor lines will prevent the encroachment of wharves upon the channel proper.

A belt railroad will be built on each side of the harbor, with spur tracks extending to industrial plants and wharves. An effort will be made to get from the state legislature 3,600 acres of submerged lands as sites for industrial plants. The effort is being made in every way to facilitate the movement of vessels, cars and freight.

Rising Prices Halt Detroit's Sewer Work

A shortage of material—cement, sand, gravel and brick—has brought to a standstill Detroit's huge public sewer program. One contractor has notified the department of public works of his inability to complete his job due to the increased cost of labor and material, and others are expected soon to follow the same course.

The present situation may force the city to adopt a new form of contract, recommended by the special sewer commission, providing for the payment of 75 per cent of all labor and material costs above a fixed schedule of prices made at the time the contract is let.

Since July first, contracts in the sum of $5,800,000 have been let for sewer work on which nothing has been done, according to Controller Henry Steffens, Jr., and $1,722,000 worth of work has been done in the same period.

Snow Removal in Denver

Denver's interesting periodical called *Municipal Facts* in its April-May issue states that the big snow of April 17 broke all Denver records as a heavy snow storm and also as to the time in which it was removed. The unusual speed of removing is attributed to the complete co-operation between all bureaus of the Department of Improvements and Parks. All highway trucks and teams, as well as the Park Department outfit, were used, including a number of trucks recently received from the Federal Government through the State Highway Commission and a number of heavy trucks borrowed from local construction companies. In addition to twenty motor trucks, a caterpillar engine was used. Street car lines were tied up on Saturday and the mayor ordered the downtown streets closed on Sunday to facilitate the work, and by Monday morning the snow no longer interfered with the daily industrial life of the city.

Proposed Suisun Dam

The construction of a giant dam across the Carquinez straits in Suisun bay, from Army Point to Bullshead Point, California, is the plan offered by delta interests as a solution of the present water difficulties in the lower reaches of the Sacramento and San Joaquin rivers. The dam is intended to keep the salt water from backing into the mouths of these rivers and so assure a supply of fresh water for domestic and irrigation uses.

The dam would contain locks to permit the passage of steamers of light and heavy draught. It would be about a mile long and 53 feet high. A railroad track or roadway might be built across the top.

If the dam were constructed, it is claimed, the Suisun salt marshes would become fresh water marshes and could be reclaimed for cultivation.

Japan plans to spend 350,000,000 yen during the next ten years in the construction of a deep sea harbor at Tokio to afford facilities for large vessels which now have to dock at Yokohama 18 miles away.

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Water Works Expenses and Incomes

One of the leading papers at the 1919 convention of the American Water Works Association gave the results of an investigation into the effect of the war on water works departments and companies. A paper scheduled for this year's convention entitled "The War Burden of Water Works in the United States Continues," will probably adduce later and additional facts to prove the disadvantage under which high prices and the scarcity of materials have placed practically all water works properties.

In this issue and last week's we present figures from several score of cities in all parts of the country showing the extent to which cost of construction and operation has been increased since 1914. In a general way these figures show that these costs have about doubled, on the average. It is also shown that the wages paid to water works employees have been about doubled on the average and have been increased to some extent by nearly all plants. The salaries of superintendents also have increased on the average 25 to 50 per cent.

But when we look on the other side of the ledger for the increased income whereby these additional expenses are met, we find that less than one-half and probably not more than one-third of the water companies have increased their water rates at all, and the majority of those which have made increases have kept these well under 50 per cent. The question naturally arises, how long the companies can continue under increased burdens without commensurate increases in income and remain solvent, and how long water departments can operate under similar conditions and still continue to maintain that financial independence of the municipal treasury which has come to be generally recognized as desirable and almost essential to economy of operation and business-like financing.

It would seem to be demonstrated by the figures available that, unless prices come down very soon, the remaining half or two-thirds of the plants of the country must increase their water rates by at least 50 per cent. We believe that the people have learned to appreciate the fact that the increased cost which they have experienced in their own living expenses affects all departments of industry as well, and that they will not make any serious objection to paying this increase, which is less than they have for months been paying for the other necessities of life.

Impartial Consideration of Vehicular Tunnel Schemes

The construction of a vehicular tunnel under the North river, New York, under consideration for several years, has been thoroughly and sometimes almost bitterly discussed by the public and by competent engineers. Commissions and engineering staffs have been appointed; large appropriations have been made and partly expended; and considerable investigation and research has been accomplished but no announcement has yet been made that either type or dimensions have been finally determined on.

The commission retained an eminent engineer to report on different plans offered to it by tunnel engineers and contractors, and this report recommended a specific type and dimensions of structure which followed advanced lines differing from the most common examples of subaqueous tunnel construction.

The recomended structure was strongly attacked with diverse objections, and eventually the commission announced that its construction would not be considered and gave several points in which they considered the design unsatisfactory.

In reply, the engineer who reviewed the subject analyzed the figures and results of the commission's engineers, and demonstrated that the chief alleged faults either do not exist or are common to this type of tunnel and to the type of cast-iron tunnel not rejected by the commission.

These data are entitled to acceptance until disproved and until then apparently leave the question open and the type of tunnel subject to choice governed by practical considerations.

The principal consideration is apparently that of precedent and this applies only in scale, not in the principles involved, which have already been successfully demonstrated. Decision should be made wholly on the merits of the case, and the most important elements are safety, durability, efficiency, rapidity and economy of construction.

The article in this issue makes a good case for the safety, durability and efficiency of the concrete-block type, which is applicable to the cast-iron type although not equally so for the different dimensions proposed in the comparative designs that have already been considered.

Efficiency is practically a direct function of the capacity, which varies with the dimensions and for either type can be arbitrarily fixed within certain practical limits, which are beyond the dimensions under present consideration. There are, however, no positive data existing as to the capacity that is actually required or as to its economic limit. An increased capacity is sure to be needed, but no one knows how rapidly the use will increase or what ultimate amounts should be provided for at this time. It is therefore wholly a question of judgment.

The claims that the concrete block tunnel can be constructed more rapidly and at a lower cost than the cast-iron tunnel are well presented and appear convincing, especially under the present conditions of the labor and material markets. This question, however, will settle itself, if permitted by the simple operation of inviting bids from responsible parties, some of whom have already offered to give security for the construction of the work at prices corresponding to those already mentioned.

It would therefore appear that the simplest and most satisfactory solution of the problem is for the engineers to definitely fix the dimensions and capacity of the tunnel, and to invite competitive bids, accompanied, of course, by proper sureties, on alternative types and details that will fill all the specified requirements, and be demonstarted to possess satisfactory strength and safety.

Under these conditions, the bidder who offers to construct the tunnel in the shortest time and for the least cost, should receive the contract.

Adjusting Labor Distribution

Although there is doubtless a considerable scarcity of labor throughout the United States, the famine is much greater in some parts than in others and there is much labor that is employed on non-essential work that might better be transferred to more imperative duties, as for instance the shifting of labor producing luxuries and performing unnecessary duties required by extravagance and carelessness, to positions where they could be efficient in more necessary occupations such as agriculture, transportation and various mechanical trades.

Furthermore, laborers could be advantageously shifted from congested centers to those that are not crowded, thus greatly relieving the critical housing problem. Most important of all perhaps is the transfer of labor from congested districts and unnecessary occupations to farms where their efforts will be productive, their personal conditions much more comfortable, sanitary and contenting. The increased production thus attained will materially assist to lower the high cost of living and with it the inflated wages, while the very fact of their transfer will eliminate some of the extravagant wages that have led to so much discontent, and the changed conditions will make the lower wages that they receive give them a greater purchasing power and secure them more comfort and satisfaction.

In line with this, comes an interesting suggestion that for a fixed period, say five years, certain classes of immigrants, especially those from agricultural sections, be forbidden to remain in New York City. With a proper Federal clearing house, allied with local industries throughout the country, this arrangement could be easily effected and would work injustice to none and benefit to all. It might be carried still farther and special inducements be made for laborers to leave New York City, where there is such an intolerable scarcity of housing and extortionate rents are required, and go to the agricultural districts where their work is demanded and where there are great numbers of empty houses, 24,000 being reported from New York State and 30,000 from Michigan.

Importance of Filter Operators

The following, which appeared as an editorial in "Shop and Field News," a monthly published by the employes of the Pittsburgh Filter and Engineering Co. and edited by F. O. Leopold of that company, restates an idea that we have expressed editorially several times; but it is one that can not be stated too often or too emphatically, until such time as all water works officials realize its great importance to the citizens who depend upon them for safe water:

With the increasing number of water purification plants throughout the country, the question of qualified filter operators should certainly be given more consideration, if the most efficient results are to be obtained and a reasonable return made on public funds expended.

The day of the "handy-man" has passed and it is just as important to have a trained man in charge of your filter plant as it is in any other public position requiring a trained man. In fact, when you consider that a pure water supply is the foundation of any community and the health and welfare of your city is dependent upon one or two men for the proper operation of your filters handling a polluted water supply, it is certainly of great importance that a competent man be placed in charge.

The larger cities realize the fact and place a trained chemist in charge with properly trained operators. Is it not just as important to have qualified operators in the smaller plants?

One only needs to visit the average small town filter plant to be convinced that it is time that something was done to improve this condition.

There are of course many ways in which this could be remedied, but the most logical and quickest results could be obtained through the State Department of Health.

During the past year we have experienced an endless amount of trouble in getting operators to follow instructions given by our field engineers. Only recently we completed a very modern plant for a small city in the middle west, and within six weeks it was necessary for us to send a man back there four times to put the plant back in proper working condition, and on each trip he found that instructions had been completely ignored. This is not only one case but one of many that we can name. This evil is a useless waste of time and money and it is high time immediate and proper action was started.

Senate's Investigation of Construction Situation

The construction situation in the United States is to be investigated by a Senate Committee appointed by the vice-president, with W. W. Calder, chairman, W. S. Kenyon, W. E. Edge, E. J. Gay and J. O. Wolcott. All people possessing information regarding housing and industrial shortage are requested to communicate with the special committee on reconstruction and production, Senate Office Building, Washington, D. C.

The committee has been appointed in accordance with a resolution authorizing investigation into the existing situation in relation to the general construction of houses, manufacturing establishments and buildings and the effects of these upon other industries and upon the public welfare and to develop such measures as it may be necessary to stimulate and encourage such construction work, to encourage investments rather than spending, and to insure cooperation between labor and persons or corporations engaged in transportation, banking or other business necessary to the development of such construction.

Harbor Strikes

The congressional estimate of the cost of strikes that have affected the coastwise steamships is that since January 1st, three strikes have tied up the lines 26 days out of 118 days and since March 13 have tied up 47 vessels and more than 200 tugs, lighters and barges. Since January 1st, 1918, the cost to the public in these strikes is $86,000,000 including $12,000,000 loss in wages, $13,000,000 loss of interest on investment and $40,000,000 loss from delay, congestion and destruction of perishable freight.

Water Rates and Salaries

Data furnished by water works officials show that superintendents' salaries have been increased in most cities, employes wages in practically all; but that, in spite of this and of increased cost of materials, rates have been raised in only about one-third of the cities, and but little in most of these.

Last week we presented a number of tables showing increase in cost of materials used in the operation of water works in all parts of the country. This week we give a table showing the increases in salaries of superintendents and wages paid to other employees, and also the increases made in water rates by the several cities during the past twelve months. Increases made prior to a year ago we set forth in a series of tables published by us in our issues of July and August, 1919.

Considering first the matter of superintendent's salaries, we find that only 11½% of those reporting have received no increase; 34.5% received 25% or less; 34.5% received an increase of between 26 and 50%; 8.8% an increase of 51 to 75%; 8.8% 76 to 100%; and 1.9% received over 100% increase. This is a better showing than we had expected, more than half of the superintendents having received an increase in salary of more than 25%.

The increase in wages of other employees was quite a little greater than that in the salaries of the superintendents, only three cities having failed to increase the wages. The increases ranged all the way from 13% to 300%. Two cities gave an average increase of more than 200%; seven per cent of the cities gave increases of more than 150%; fourteen percent gave increases of between 101 and 150%; twenty-nine and a half percent gave increases of between 76 and 100%; twenty and a half percent increases of between 51 and 75%; twenty-three and a half percent increases of between 26 and 50%; and five and a half per cent increases of less than 26%. More reported 100% increase than any other one figure. The average increase, including all the cities reporting, was 84%.

WATER RATES

In spite of the very considerable increase in wages and salaries, in cost of coal, pipe and other water works materials, the increase in rates has by no means kept pace with it. Reference to the tables in last week's issue show that in most cases there has been a material increase in cost of these materials since a year ago, that in coal having been half as great as during the five years previous. But less than ¼ of the cities report having increased their rates during the past year. It is interesting to note that this condition exists quite generally throughout the country.

Dividing the states geographically into New England, Middle Atlantic, Southern, East Central, West Central, Rocky Mountains and Pacific Coast, we find the percentage of cities in these several divisions which have made no increase in their rates to be 78, 70, 71, 78, 78, 100 and 71 respectively. The increases made in rates in the several divisions may be generally described as follows: New England—8.6 to 30¼; Middle Atlantic—10 to 50%; Southern States—8 to 20%; East Central—10 to 50%, with one city reporting 100% increase in rates with no increase in salary or wages; West Central—6 to 15%; Rocky Mountain, 0; Pacific Coast, 15 to 40%.

SUPERINTENDENT'S SALARIES

Considering the increase in superintendents' salaries for cities classified in the same way, we find in the New England States only one salary not raised, while the increases vary between 7.4% and 60%. In the Middle Atlantic States 6 superintendents did not have the salaries raised, and the raises in the others vary between 5 and 100%. In the Southern States three salaries were not raised and the increases in the others varied between 5 and 225%. In the East Central States three salaries were not raised, and the increase in the others varied between 7½ and 111½%. In the West Central States two salaries were not raised, and the increases varied between 6 2-3% and 100%. In the

INCREASES IN WATER RATES, SALARIES AND WAGES

City and State	Percentage of increase since 1914 in superintendent's salary	in wages of other employees	Increase in water rates since June, 1910
Alabama:			
Gadsden	33 1-3	100	None
Mobile	7	23	None
California:			
Palo Alto	43	40-100	28
Redlands	10	60	None
San Francisco	20	73 2-5	None
Colorado:			
Boulder	20	50	None
Colorado Springs	26	20	None
Delta	None	10—15	None
Connecticut:			
Putnam	33 1-3	157.14	8.6
Southington	10	148	None
Winsted	10	100	None
Delaware:			
Lewes	65	55	20
Wilmington	41 2	76.01	None
Florida:			
Pensacola	20	50	None
Georgia:			
Albany	40	100—200	None
Cedartown	12	50—60	8
Thomasville	83	112	20
Valdosta	25	Engineers, 70. Wage hands, 300	None
Idaho:			
Lewiston	20	100	None
Sandpoint	50	50	None
Weiser	12½	25	None
Illinois:			
Bushnell	100	...	None
Chicago Heights	50	70—100	50
Duquoin	40	110	None
Mattoon	25	70	10
Monmouth	35	40	None
Quincy	66 2-3	63 1-3	None
Rochelle	60	90	None
Rock Island	None	70 & 90	None
Sparta	33 1-3	37½	None
Waukegan	66	66	None
White Hall	7½	Reduced 33 1-3	None
Indiana:			
Columbia City	60	50	None
Delphi	33 1-3	87 1-7	None
Evansville	50	50—125	None
Garrett	40	20	None
Kendallville	88	50—75	None
La Porte	25	100—150	None
Lebanon	70	100	None
North Manchester	0	82—300	None
Richmond		50—65	7
Shelbyville	13.6	50	None
Terre Haute	25	63	10
Union City	25	33 1-3	20
Whiting	..	None	100
Iowa:			
Algona	50	60	7½
Atlantic	25	45	10
Cherokee	50	56	None
Denison	15	50	15
Maquoketa	36.36	28.20	None
Sioux City	35	26	None
Kansas:			
Council Grove	50	75	None
Emporia	11 2-3	100	5
Fort Scott	100	90	None
Fredonia	50	100	None
Kentucky:			
Providence	None	33 1-3	None
Louisiana:			
New Iberia	None	75	None
Maine:			
Lisbon Falls	60	62	None
South Paris	40	100	None
Maryland:			
Hagerstown	1	50	10
Massachusetts:			
Athol	23 1-5	31 1-3	None
Cherry Valley and Rochdale	20	130	20
Cohasset	17½	100	30
Lenox	None	100	None
Mansfield	33 1-3	140	None
Maynard	33 1-3	35—40	None
Millbury	42	170	None
New Bedford	38 3-5	80	None
Somerville	34.8	86	None
Springfield	10	20—150	None
Winthrop	20	50	None
Woburn	48	125	25
Worcester	7 2-5	100+	None
Michigan:			
Battle Creek	41	120	None
Belding	78	1.87	None
Charlotte	50	50	None
Crystal Falls	25	78	None
Highland Park	75	87—190	20
Michigan (Continued)			
Lansing	50	50	None
Ludington	20	25—50	25
Manistique	91 4	100	None
Onoway	40	125	None
Saginaw	None	55—180	None
Minnesota:			
Cloquet	50	100	None
Fergus Falls	None	100	...
Hutchinson	40	80	None
Lake City	27	50	None
Rochester	40	100	...
St. Peter	20	20	None
Stillwater	33 1-3	112½	None
Mississippi:			
Canton	175—225	100	None
Greenwood	70	100	15
Jackson	5	25—100	None
Missouri:			
Chillicothe	50	60	None
West Plains	20	20—40	None
Montana:			
Havre	33 1-3	90	None
Nebraska:			
Hastings	50	70	10
Now Jersey:			
Bridgeton	20	175	None
Hawthorne	50	50	50
New Mexico:			
Roswell	None	30	None
New York:			
Albany	None	5—86	50
Norwich	None	196 1-3	40
Ogdensburg	6 2-3	178	None
Potsdam	20	100	None
Syracuse	5	15—150	None
Watervliet	None	None	Decreased 10
Wellsville	100	100	10
North Carolina:			
Charlotte	16 2-3	35—175	None
Henderson	50	100	None
Raleigh	10	25—100	None
North Dakota:			
Valley City	25	...	None
Ohio:			
Barnesville	30	50	50
Coshocton	75	50	None
Delaware	15	60	30
Franklin	50	50	None
Lakewood	60	71—133	None
Martin's Ferry	100	50	None
Newark	15	75	None
Niles	100	160	None
Toronto	100	100	None
Van Wert	25	25	None
Wilmington	111.54	85.94	None
Oklahoma:			
Perry	50	100	15
Sapulpa	20	20	45
Oregon:			
Eugene	13	75—100	15
Portland	16 2-3	50	None
Pennsylvania:			
Clearfield	100	125	...
Indiana	None	33	None
Lebanon	None	100	None
Reading	None	100	None
Sewickley	80	250	None
Sharpsville	20	150	None
Stroudsburg	20	50	None
South Carolina:			
Newberry	52	52	Reduced 10 5 raise on min.
Tennessee:			
Dyersburg	50	50	None
Murfreesboro	100	100	15
Texas:			
Georgetown	9½	25	None
McKinney	66	40	None
Stamford	None	100	None
Taylor	20	50—100	None
Temple	6 2-3	65	None
Waco	15	50	None
Virginia:			
Charlottesville	None	125	None
Richmond	None	40—50	None
Washington:			
Auburn	50	63	40 reduction
Chehalis	26.6	50—100	None
Wisconsin:			
Jonesville	50	140	None
Oconomowoc	36	78	None
Wyoming:			
Cheyenne	16 2-3	100	None
Green River and Rock Springs	59	58 1-3	None

Rocky Mountain States two were not raised, and the increases varied between 12½% and 59%. In the Pacific States all salaries were raised, the increases varying between 10% and 50%.

WAGES

In the matter of wages, all New England cities reporting raised the wages of their employees from a minimum of 31.2% to a maximum of 170%. In the Middle Atlantic States only one city has not raised wages, the increases varying from a minimum of 5% to a maximum of 250%. In the Southern States all cities report raising wages, from a minimum of 23% with a maximum of 300%. In the East Central States, one city reports decrease in wages and another made no change, while the remainder report increases varying from a minimum of 20% with a maximum of 300%. In the West Central States all cities report raise in wages, from a minimum of 20% to a maximum of 112½%. In the Rocky Mountain States all cities report raise in wages, from a minimum of 10% to a maximum of 100%. On the Pacific Coast all reports raise in wages, from a minimum of 50% to a maximum of 100%.

Dividing the increases into those less than 26%, 26 to 50%, 51 to 75%, etc., we find increases as follows, grouped geographically:

	1% to 25%	26% to 50%	51% to 75%	76% to 100%	101% to 150%	151% to 200%	201% and more.
New England	..	17	6	39	28	10	..
Middle Atlantic	..	23½	6	35	12	17½	6
Southern	5	5	32	21	21	..	5
E. Central	4¼	30	17	25½	17	6¼	..
W. Central	8½	21	29	37½	4	..	..
Rocky Mt.	30	30	10	30	..	..	..
Pacific	..	14	71	15.	..	..	..
Entire Country	5½	23½	20½	29½	14	5½	1½

Concrete Block Vehicular Tunnel Investigation

Development of proposed plan. Governing conditions. Plans for design. Advantages of Precast Concrete Block shell. Objections to concrete blocks refuted. Adverse Analytical hypotheses untenable. Capacity, stresses, strength, stability, durability, rapidity of construction, methods of construction and cost. Conclusions favor wide roadway, concrete shell without cast iron, and adoption of advanced practice effecting 50 per cent economy.

Prior to 1917 there had been proposed for the vehicular tunnel under the Hudson river between New Jersey and New York City two principal alternate types, one of them consisting of two single-way cast-iron ring tunnels similar to the existing Pennsylvania Railroad tunnels; and the other, a reinforced concrete structure built in sections on shore, floated, and sunk to place in a deep trench excavated for the purpose.

The New York State Bridge and Tunnel Commission, having studied the problem, retained General George W. Goethals to examine the different proposed plans and make a definite recommendation. From a study of these plans and all of the physical data available, it was evident that the cross-sectional dimensions required to be greater than any heretofore constructed, and General Goethals believed that they could be most readily and economically secured by the adoption of the reinforced concrete type laid under cut-and-cover conditions, provided these were found to be practicable.

TYPE RECOMMENDED

Extensive detailed studies of the bottom of the river at the proposed location were made from a large number of available data and these, together with previous experience in handling similar material, convinced General Goethals that it was exceedingly doubtful if the trench could be maintained except at expense so great as to be considered prohibitory. Further investigation was therefore concentrated on the shield-driven type of tunnels, which have already been successfully constructed both with cast-iron lining and precast concrete blocks. It was considered feasible to construct cast-iron lined tunnels of 30 feet in diameter, but, on account of war conditions, it was thought doubtful whether the cast iron could be secured when needed, and if it could be purchased except at an extremely high cost.

A preliminary study of precast concrete lining indicated a great saving in cost, and this method was advocated by the head of a firm of contracting engineers which had done more actual tunnel work in the North and East rivers than any other concern, and which was experienced with block tunnels of smaller diameters. After close study of details and an analysis of stresses for different size tunnels made with concrete block rings, General Goethals recommended their use for a tunnel of 36 feet inside [illegible] with two roadway levels 24 feet 6 inches clear width between walls and 22 feet 6 inches between curbs.

OPPOSITION TO PRECAST BLOCKS

After receiving this report, the commission issued a statement that the concrete block tunnel type would not be adopted and stated that its capacity had been greatly over estimated; that the strength of the rings is not sufficient to withstand the external load; that the construction is not suited to Hudson river conditions; that the estimates of its cost were too low; and that the tunnel could not be built within a period of three years.

After the merits of the different types of tunnels had been discussed by engineers and laymen at several public and private meetings, General Goethals requested a copy of the data from which the abovementioned conclusions had been drawn. The request having been complied with, Gen. Goethals studied these data and on April 2nd submitted to the commissions a comprehensive report on the data and on the designs for both cast-iron and concrete-block tunnels of which the following is an abstract*

CAPACITY

Previous to General Goethals report of November 24th, 1917, some engineers strongly urged provision for only single lines of traffic and there was no advocacy of the necessity of providing for more than two lines of traffic in each direction. Present ferry and bridge traffic apparently did not give a fair index of the increase to be anticipated and General Goethals deceided that a vehicular tunnel providing for less than three lines of traffic would be a mistake. He concluded that a clear width of 24 feet 6 inches between walls would be ample for 90 per cent of the traffic in three parallel lines, thus providing abundantly for actual operating conditions of two streams of traffic with cars continually swinging out and passing ahead into line. Later considerations point to the advisability of considering an increased width of 25 feet for roadways placed in two single track tunnels constructed of concrete blocks.

STRUCTURAL STRENGTH

If a given tunnel be constructed in a hole excavated larger than the exterior dimensions of the structure, the construction stresses in the latter will be different from those that would arise if the structure exactly filled the hole and continuously supported the surrounding material. In the former case, the movement of the material produces variable forces which, in the actual case of the Pennsylvania tubes, required the design to have sufficient strength to resist forces of unknown magnitude which distorted the ring and made it necessary to support the interior by means of vertical timbering or horizontal tension members, which were not always sufficient to prevent the breaking of the cast iron rings.

After the material came to rest around the exterior of the rings, the ring returned approximately to its circular form, indicating the action of forces normal to the ring. If a tunnel can be built so as to completely fill the excavated hole continually and prevent movement of the external material, the conditions will approximate those existing in the Pennsylvania tunnel after completion as indicated by recorded pressure readings.

THEORY OF STRESS

The assumptions used in analyzing the block tunnel by the commissions are based on a theory that assumes the material to be perfectly fluid, except as influenced by the friction of the individual particles of the material, and ignores the existence of cohesion; in other words, a perfectly granular material. These assumptions applied to block tunnels, for a material having a stiffness expressed by an angle of repose of 13 degress, lead to results that indicate the unsafeness and structural defectiveness of the block tunnel. If, however, these same assumptions are used in the analysis of the cast-iron tunnel during construction, either for the existing Pennsylvania tunnels before the interior concrete had been placed, or for the commission's engineers' proposed cast iron tunnel before concrete is placed, the forces are of such magnitude and of such direction that they give an unsafe condition for the cast-iron rings, in that the tension in the cast iron rises upwards of 9,800 pounds per square inch. This is an unsafe stress for cast iron, and does not allow for an increased tensile stress developed, of unknown magnitude, resulting from the kinetic energy of the material moving through the exterior space until it comes in contact with and is brought to rest by the ring.

The construction of the proposed concrete-block tunnel involves methods that result in a tunnel being built of the actual outside diameter created by the shield in its travel forward, so that the surrounding material is not allowed to move and is constantly supported as the shield moves forward. The pressure diagrams of the Pennsylvania tubes show the forces such a tunnel has to resist.

MATERIAL PENETRATED IS COHESIVE

In support of the recognition of the existence of cohesion, it may be pointed out that before any readings on the gauges could be obtained in the Pennsylvania tubes, it was necessary to destroy the cohesion of the material immediately in contact with the ring, by stirring it up with a bar passed out into the surrounding material. This fact is further borne out by the fact that segments of the tunnels have been removed and the material stands unsupported until broken down by a flow of water, destroying its cohesion.

An analysis of the forces acting on a tunnel built in such a way as to fill the annular area immediately in the rear of the tail of the shield, if applied to the existing Pennsylvania tunnels, will give pressures following very closely the pressures actually read in these tunnels.

EFFECTS OF GROUTING AND GRAVELING

During the construction of the North and East river tunnels, it was the practice to fill with grout the exterior annular space left by the shield tail. As this did not prevent movement of the earth, distortion and breaking of the cast iron ring continued. Later, the methods of forcing fine, dry gravel under high pressure into the annular space was perfected and can be used in very soft material.

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*The report was accompanied by diagrams and computations demonstrating the conclusions arrived at and furnishing data for the figures given, which are consistent with this abstract but are here omitted for lack of space.

leaving the tunnel roof in solid gravel and eliminating distortion and unsafe stresses.

FLOTATION AND LONGITUDINAL STRENGTH

On the theory of driving the tunnel through granular material without cohesion, the stress sheets of the Commission's engineer show that the concrete-block tunnel is structurally sound for materials having angles of repose under 6°, but that in material of 3° angle of repose, it would float. The same reasoning shows that, under the same conditions, the proposed 29-foot cast-iron tunnel would float and that the existing Pennsylvania Railroad tunnels would have floated.

The voussoir blocks making up the concrete-block tunnel rings are bolted to each other throughout the length of the tunnel on exactly the same principle as the bolting of successive rings of the cast iron tunnel, and the bolts have a greater aggregate longitudinal strength than those of the latter tunnel. The small joints between the voussoirs are much less numerous than those between the bricks in a 2,000-foot length of the north Christopher street tunnel, built many years ago and through which trains are now operated. The criticisms that the tunnel is lacking in longitudinal strength and is impaired by dangerous small joints are not valid.

GENERAL STRESS ASSUMPTIONS

Summarizing, the above statements as to structural strength may be covered as follows:

"Theory of granular material, used by engineers, is incorrectly applied to this material, as shown by (a) Great amount of cohesion. (b) Absence of large active horizontal forces in material as shown in existing Penn. R. R. tunnels.

"We have applied theory, based on following assumptions: (a) Vertical pressure at top of tunnel equal to weight of material, (b) Algebraic sum of vertical forces equal to zero, (c) All pressure normal to surface of tunnel, (d) Pressures increase at a rate uniform for each foot of depth (determined for our computations by above assumption.) These assumptions are based on the use of gravel packing back of the shield. Comparison with pressure readings taken in Pennsylvania tubes shows variation of less than 10 per cent from results of our normal pressure formulae.

"Your engineers have applied their assuptions of granular material having an angle of repose of 13 degrees to the large two-level block tunnel, and we have checked their figures very closely. We have applied these assumptions to a smaller block tunnel having a single roadway 25 feet between curbs, to the cast-iron tunnel 29 feet in diameter recommended by your engineers, and to the Pennsylvania tubes, 23 feet in outside diameter, cast iron.

"We believe these assumptions are incorrect, but the results of computations based on them show that the tensile stresses in the 29-ft. cast-iron tunnel, and the 23-foot Pennsylvania tunnels, are far beyond the allowable safe limit for cast iron, as is likewise found to be the case for the tensile stresses in the concrete-block tunnels under the same assumptions."

Normal pressure formulae applied to these tunnels show safe unit compressions of 310, 270, 1,840 and 1,645 pounds per square inch in the 42-foot and 36-foot 6-inch concrete tunnels and the 29-foot, and Pennsylvania cast-iron tubes respectively. No tensile stress is found in any of the four types.

Cohesion of the material penetrated reduces the active pressure on the tunnel rings and increases the passive resistence. This latter is not included in Mr. Goethals theory, thus giving an additional factor of safety that exists only when packing is used. In order to break, the ring must deform; in order to deform, the ring must move against the material at some point; in order to move, it must overcome large passive forces.

The assumptions made by the commission's engineers, by which they calculated the block tunnel to be unsafe, would, if applied to the cast-iron tunnels, also show them to be unsafe.

IMPORTANT PRACTICAL CONSIDERATIONS

The joints of the tunnel will be grouted watertight, the concrete will not be deteriorated on account of reinforcement, because it does not exist, and there will be no seepage through the concrete.

The estimate of cost of a 36-foot block tunnel was basel on prices of 1917 and on the experience of the O'Rouke Construction Company, and the $12,000,000 was exclusive of the property and right-of-way.

"The cost could have been definitely settled, however, by following my recommendation to invite, from experienced parties, definite bids for specific dimensions and location, leaving the type of structure to the choice of the bidder. The failure to do this leaves the project no farther advanced than it was a year ago.

"A vehicular tunnel providing for less than three lines of traffic in each direction, if adopted, I consider would be a mistake in judgment and a lack of vision, on the part of those responsible, as to future demands of the continued growth of the cities of New York and New Jersey.

"Concrete, as a material unassisted by cast iron, is pre-eminently suitable for tunnel construction and the proposed concrete block type is sound in engineering principle, practicable to build, structurally safe, will not float or sink, and finally, is far more economical than cast iron.

"The paramount question still remains: Will your Commission, simply because fearful of attempting something which heretofore has not been tried out in its entirety, recommend the expediture of $26,000,000 to $30,000,000 to create facilities for a vehicular crossing of the North river, when $10,000,000 to $12,000,000 less than this amount will accomplish the desired end?"

Keeping Hogs, Ducks and Geese in Cities a Nuisance

The State Department of Health of Ohio, in its official publication, has registered an emphatic protest against the relaxation of the regulations which most communities have adopted preventing the keeping of hogs in towns. It considers the average pig pen as an unexcelled breeder of flies, which flies are carriers of typhoid fever and of other intestinal disorders. Moreover, the existence of filthy pig pens cannot be expected to have any effect other than damaging upon a community's sanitary standards. Commenting upon this, the Division of Health of Toledo reports that 256 pigs were either slaughtered or removed from that city during 1919 through the activities of the Bureau of Sanitation and asserts that "the pig must go from Toledo." In this connection it says: "Another almost equally as bad nuisance as the pig is the raising of ducks and geese in the city, which was countenanced as a war measure in 1917-1918, since which time they have increased in great numbers, many people using them as a means of disposing of theirs and their neighbors' garbage. Through the effort of our inspectors this year, 442 were disposed of. The fight against the ducks and geese, as with the hog, will be carried on with greater determination in 1920."

Trees and Streets

In a discussion of the subject of shade trees before the League of California Municipalities, the action to be taken where trees and street lines interfere, and public control of shade trees, received attention.

A paper advocating ornamental shade trees for cities was read before the League of California Municipalities recently by A. E. Shamel, of the Park Board of Riverside, Cal., following which there was a discussion as to the extent to which shade trees should be controlled by the city and should be permitted to modify the development of streets, and especially roadways, for purely traffic purposes.

Mr. Shamel stated that Riverside had about 75,000 shade trees which, if placed in a continuous row, would extend more than 700 miles. This is more notable when it is considered that more or less irrigation is necessary in that section of the country for the raising of trees. For instance, 8,000 of the younger trees had been irrigated with a tank wagon three times during the week previous to the presentation of this paper. The city has appropriated $7,668 for the care of these trees this year. This work is under the care of a tree warden, who has from three to six men under him.

Following the paper, the commissioner of parks of Pasadena, J. J. Hamilton, asked concerning the desirability of leaving trees in the middle of streets, which started a discussion on public versus private control of shade trees. One member stated that, in his opinion, no tree was ever beautiful enough to leave in a street if it endangered life, and in these days of rapidly moving automobiles the question whether a tree was so situated as to be dangerous to night travel by these was the most important one.

The city attorney of Santa Barbara, W. P. Butcher, stated that the principal object of a street is travel, this being what they are designated for and laid out for. Railroads are permitted to run over them because they facilitate travel, and certain things are permitted to be placed upon them so long as they do not interfere with travel; but if anything interfered with that use of the street, it should not be tolerated. Replying to these, Mr. Shamel said that the engineer's point of view was that, when a tree is in a road, it should be cut down; while the tree lover's idea is not to cut out the tree, but to go around it—that an individual is here for 50 or 75 years, while the tree may be here for 300 or 500 years. It may be necessary to remove it, but the subject should be given great consideration, each case being studied separately.

The public control of trees also was discussed. In Los Angeles, the Board of Public Works has the power to grant a permit to take out a tree but no power to say what kind of tree shall be put in to replace it. This might result in a gradual changing of a city's plans for uniformity of shade trees, and introduce unsightly confusion. To prevent this, the Los Angeles Board will not grant a permit for removing a tree until it has received a pledge in writing that it will be replaced with the kind of tree desired by the city authorities. City manager J. W. Watson, of Glendale, stated that the city eliminated most of the opposition and discussion as to the kind of trees to be planted, by having the city furnish the trees, and plant and maintain them. It had found that the overhead cost, and loss of time and energy in discussing the kind of trees to be put in, and friction among neighbors in deciding on the kind of tree for a given street, were unnecessary and could be prevented by having the trees grown by the city in the municipal nursery at very small expense and planting the trees in a street whenever it has been improved and is ready for tree planting. As there are few trees in the city as yet, this plan distributes the benefits very equally throughout the city. In this way property owners get trees at less cost than in any other way, and there is practically no difficulty in persuading them to accept the kind of tree which the city wishes to provide and thus securing uniformity not only in kind but also in age or size of trees along a given street. The city now has about 7,000 trees in the nursery ready for planting, and expects to call upon the citizens to assist in the planting this year by having a tree planting day. In this way not only the trees themselves but their planting will be obtained by the citizens at a minimum of cost and after a uniform plan.

In San Diego the engineer has been instructed by council that in preparing plans for improving any street he shall incorporate the planting of trees, the kind of tree to be selected by the majority of the owners if they desire, or it may be selected by the engineer and street superintendent. This including of tree planting as a part of the street improvement is a new proceedure but has met with no objection in the four cases in which it has already been carried out.

In Berkeley the trees to be placed on a given street are designated by the street superintendent, a time for protest being fixed (which is quite short), and an assessment is made under the Tree Planting Act against the front footage of property after a determination by the engineer of the amount that will be necessary. The act provides that the assessment may be levied by attaching it to the tax-bill and may be paid in annual instalments instead of in a lump sum.

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Measuring Internal Pressures in Hydraulic-Fill Cores

An earth-pressure cell, used by the U. S. Bureau of Public Roads, was adopted for this use and several were buried at different depths in the semi-fluid core, where the relation between horizontal and vertical pressure indicated the rate of solidification of the material.

In hydraulic-fill dams, such as were described in the issue of Public Works for May 8, the core is the critical point in the design and construction, the remainder of the dam furnishing merely the dead weight which holds the water-tight core in place. The core in the dams of the Miami Conservancy district is composed of clay and silt with considerable quantities of very fine sand, the entire material being as fine as cemmercial cement. Such material consolidates very slowly in the bottom of the pool, especially where clay forms a large proportion of it, in which case the core may retain its water and remain semi-fluid for weeks and even months. In the Calavaras dam in California this condition persisted for more than a year.

Although in the Miami Conservancy dams the core contains a relatively small proportion of clay, and careful study gave assurance that the hydraulic-fill method, using the material there available, would be a safe and economical one, it was deemed wise to endeavor to watch the process of consolidation in the core, so that it might be known absolutely that proper solidification was secured. Such a study of core materials has never been kept hertofore in a hydraulic-fill dam, and no method had ever been devised for it, save the very crude one employed at Calavaras of sounding the pool with a six-inch cast iron ball to see how far the ball would penetrate. The conservancy engineers wished for something better, and the means em-

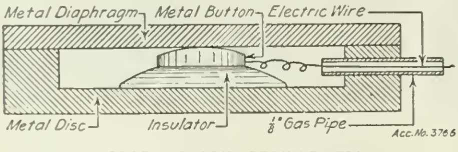
UNFINISHED HYDRAULIC-FILL DAM AT GERMANTOWN, SHOWING TOWER FROM WHICH PRESSURE CELLS ARE SUSPENDED. CORE POOL IN CENTER FOREGROUND, WITH "BEACH" ON EACH SIDE.

ployed by them are described in the Miami Conservancy Bulletin, from which the following description is abstracted.

The clue to the means employed was furnished by the investigations of the U. S. Bureau of Public Roads as to pressures on the concrete floors of bridges when covered with an earth fill and subjected to loads, the object of these investigations having been to furnish figures to be used in bridge design. To ascertain these pressures, that bureau had originated (through A. T. Goldbeck) a device which would measure earth pressures in a manner analogous to measurement of steam pressure by a steam gauge. It occurred to the conservancy engineers that by applying these pressure cells to measuring the pressures within the cores at various depths as the dams were built up, it might be possible to arrive at a knowledge of the solidification of the core materials. The general reasoning was as follows:

A core or other material, while in a fluid condition, exerts pressure equally in all directions. When the material becomes solid, however, the horizontal pressure does not exceed 1/3 to 1/4 of the vertical pressure; while in intermediate plastic stages, the horizontal pressures will be intermediate between those of a liquid and a solid. Therefore, the ratio of the sidewise pressure to the downward pressure at any point will be a measure of the degree of solidification reached at that point. As the Goldbeck pressure cell registers pressure in one direction only, by placing two of these at a given point, one measuring vertical and the other horizontal pressure, a comparison of these two pressures will indicate the degree of solidification at that point. By noting the pressure of a pair of cells at regular intervals of time, it is possible to obtain a complete history of the process of core solidification throughout the entire period of the construction of the dam.

This idea was used as the basis of the plans carried out, during the development of which Assistant Chief Engineer Charles H. Paul made several visits to the Bureau of Public Roads in Washington, and the bureau itself conducted a preliminary investigation for the district with pressure cells suspended in a 30-inch standpipe 41 feet high, into which a mixture of clay and water was introduced under conditions approximating those in the core of a hydraulic fill dam. This investigation demonstrated the feasibility of the plan. The Bureau of Public Roads also sent Mr. Goldbeck to Dayton to co-operate in the installation of the apparatus in the dams.



GOLDBECK EARTH PRESSURE CELL

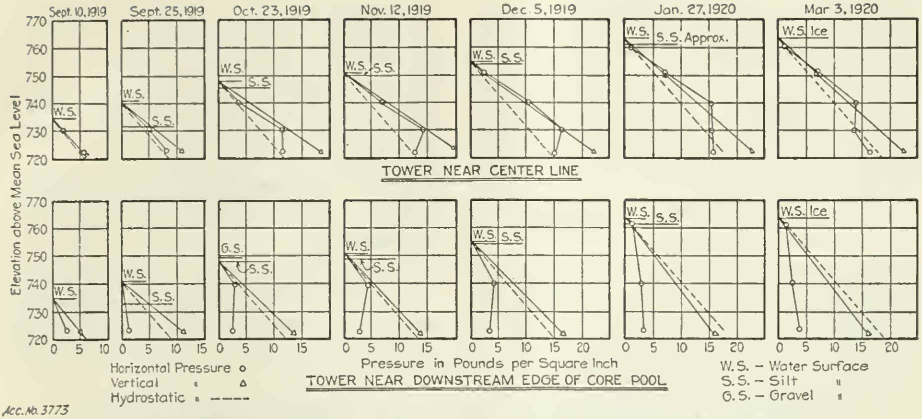
For greater clearness, this is shown as a diagram rather than as an exact cross section. The cell is a hollow metallic disk, one face of which (top face above) is an elastic metal diaphragm. The cell is buried in the earth of the dam. The earth pressure keeps the diaphragm pressed against the rounded surface of the meatl button, thus closing an electric circuit carried by wires to the top of the dam through a smal air pipe, as shown. When a measurement is to be made, air is admitted into the hollow of the cell from a compressed air tank on top of the dam, thus balancing the earth pressure, till, just at equilibrium, the diaphragrm is forced outward, breaking the electrical contact with the button. The break is indicated by the going out of a small electric indicator lamp in the circuit. The pressure is then read on an air gage connected with the air pipe line.

The accompanying illustration and the description subjoined to it explain thoroughly the construction and operation of the pressure cell.

The method of installation of the cells depends on the type of dam outlet structure. At three of the dams there are spillways between heavy retaining walls which extend entirely through the earth embankment up to its full height, and in these dams the cells are supported on the back faces of these walls. At the Germantown and Englewood dams the spillway is a separate structure and no such walls exist. Here the plan provides for supporting the cells on three light wooden towers, one near the center line of the core and one near each of its two faces. These towers are built up section by section as the material in the dam rises during construction. Cells are attached to these towers at intervals of ten feet in depth for measuring lateral pressure and at intervals of 30 feet for measuring vertical pressures. The pipes carrying the air pressure to the cells are suspended vertically from the tops of the towers. The compressed air tank, air gauges, etc. are carried on a platform at the top of the tower. In order that the pressure cells may settle with the material in the core, each cell with its ascending air pipe is suspended by a wire running over a pulley at the top of the tower, the other end of the wire carrying a counter-weight. The air tank and air gauge are connected to the top of each pipe by a rubber hose with a valve.

Observations of these gauges have been and are being made at monthly intervals, and the measurements are plotted on diagrams to facilitate study and comparison. Severel such diagrams for the Germantown dam are shown in the accompanying illustration, in which the upper row refers to cells near the center of the dam and the lower row shows conditions in the gravel slope near the downstream edge of the core. Each rectangle gives the results of one full set of monthly observations. The depth of the cell is indicated by its distance below the line W. S., indicating water surface in the pool, and S. S. indicating the surface of the silt; while the horizontal distance from the zero ordinate indicates the pressure.

For example, in the left upper rectangle the upper small circle indicates that on September 10, 1919, there was a horizontal pressure of about two pounds per square inch in a cell 4.5 feet below the level of the water in the core pool. In the same diagram, the circle and triangle near the bottom practically coincide, showing that at that depth, about 12 feet, the vertical and horizontal pressures were practically the same, indicating that the mud at this point was still practically liquid. The dotted lines in each case indicate what the hydrostatic pressure would be if the core material were water instead of mud, and in the diagram under consideration the pressure is seen to be slightly greater than the hydrostatic pressure would be.



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DIAGRAMS OF EARTH PRESSURES RECORDED IN HYDRAULIC FILL OF GERMANTOWN DAM.

The second diagram shows that 15 days later the water surface in the pool had risen 6 feet higher and that a distinct surface of silt had formed at the bottom of the pool about 9 feet below the water surface. At a depth of about 18 feet below the water surface the vertical pressure was about 11 pounds and the lateral pressure about 8 pounds, thus indicating a stiffening of the mud at this depth. Following these bottom pressures through the series of diagrams, it is seen that the horizontal pressure increases slowly as the water surface is raised, but by January 27 had become less than the normal hydrostatic pressure.

The diagrams also indicate that below a depth of 25 feet, the horizontal pressure remains constant, although the depth of core material is steadily increasing and the vertical pressure increases at the same time. "Analysis which cannot be given here would seem to indicate that this means a sufficient stiffening of the core material such that, if a cube of it were cut several feet high, it would stand alone like a piece of cheese. Explorations are in progress to ascertain by examination of the actual materials whether this is the true state of affairs. If so, it will constitute an additional assurance in this important matter. In any case, there can be no doubt that the pressure cells have already proved their value in action and have indicated a condition of the core materials which is very satisfactory to the engineers in charge.

"This is no less true of the materials in the sand and gravel retaining embankments between which the core lies, as may be seen by an inspection of the lower row of rectangles, showing the conditions just outside the pool margin, where the materials, by their open, porous texture, permit free drainage of the water which slowly escapes sidewise and downward from the core. This is an important function, and the lower diagrams show that the porous materials are performing it in a highly satisfactory manner. The small circles show that the horizontal pressure at the bottom of the dam, in these materials, never exceeds 3½ pounds, although the water pressure alone, at the depth reached by the material in the last two diagrams, would be about 19½ pounds, if the water were confined."

Illinois Highway Situation

In 1919 the state of Illinois contracted for the struction of 600 miles of highway, agreeing that if the state were unable to furnish cement the contractor should buy it in the open market subject to the approval of the state. Because the state has been unable to buy it, only about 160 miles of the road have been completed and contractors are threatened with a heavy loss on equipment, organization and overhead through the delay. They have expended considerable sums, assumed risks and undertaken obligations to carry out their contract, but the state officials are now unwilling to pay the heavy cost of getting cement to the work caused by transportation conditions.

The contractors have proposed that the state take over the job and equipment and materials stored and properly adjust each contract. The state claims it has no authority to do this and asks the contractors to voluntarily relinquish a large proportion of their jobs. The bulletin of the Associated General Contractors of America suggests that "the contractors get together in an association of sufficient strength to force the state to play fair."

Michigan Roads Injured by Traffic

State and county highway commissioners of Michigan and representatives of the federal highway commission recently held a meeting to discuss the question of destruction of roads by heavy traffic. Concrete highways recently constructed in Michigan at a cost of from $40,000 to $50,000 a mile have in many instances been destroyed by the strain imposed upon them by heavily laden trucks.

While there is on the statute books of Michigan a law limiting the load trucks may carry over good roads to a certain number of pounds to the inch width of tire, this has never been rigidly enforced and it is doubtful whether enforcement would bring a real improvement in conditions. It is contended by some engineers that roads built on a heavier base, at nearly double the cost of present construction, would stand the wear of heavier haulage.

Better subgrading and drainage, absolute adherence to specifications and adequate detours for the use of the public while highways are being built were advocated also.

To Investigate Cincinnati-Hamilton Highway

Governor Cox of Ohio has ordered that an investigation be made of the Cincinnati-Hamilton paved highway. There have been rumors of fraud with regard to this road for some time. The following was issued at the governor's office:

"Governor Cox, after making a personal inspection of the paved road between Hamilton and Cincinnati, has asked the Highway Advisory Board to conduct a thorough investigation. The work was done before Mr. Taylor became Highway Commissioner. The governor, in his report to the board, says that it is such a disgraceful exhibit of inefficiency that there are at least superficial symptoms of fraud. It has been reported to the state that inspectors were changed while the work was in progress, and a preliminary survey shows that the spots of poor work and the recorded time of their completion suggest a suspicious coincidence."

New Jersey's State Highway Engineer

William G. Thompson, state highway engineer of New Jersey, has resigned his position in order to take up private engineering in New York. Watson G. Clark, of Tenafly, has been appointed temporary consulting engineer until Mr. Thompson's position can be filled.

Mr. Clark is one of the most active members of the highway commission and is conversant with the entire program of state highway construction. He has agreed to devote at least three days a week to the department.

Mr. Thompson is a native of Connecticut and served on the engineering staff of General George W. Goethals during the construction of the Panama canal. He first came to New Jersey in the capacity of assistant highway engineer, and was appointed state highway engineer in 1918.

Protest Against Suspending Highway Construction

The Portland Cement Association has issued a circular letter protesting against obstacles and delay to highway construction which will be more and more urgently needed for moving food crops in the latter part of this season and for increasing measure of relief to railroad congestion.

Santa Barbara's Gibralter Dam

An arch gravity dam constructed under unusually difficult conditions. All materials were brought to the work through nearly four miles of tunnel which formed a part of the aqueduct, there being no practicable surface trail.

A few years ago the city of Santa Barbara, Cal., purchased the property and water rights of the Santa Barbara Water Company. This company had obtained its supply from wells, but was planning to tunnel the range of mountains bordering the coast and to dam the Santa Ynez river to obtain an additional supply. The city drove a tunnel with this idea a few thousand feet, when it struck a considerable flow of water, which is now used for domestic purposes is Montecito, a city near the mouth of the tunnel.

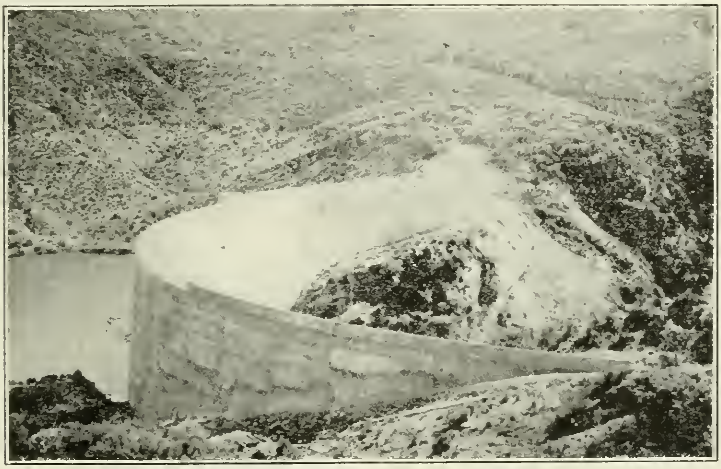
Meantime, a better reservoir basin had been found on the Santa Ynez river, and the first tunnel was abandoned and another, known as the Mission tunnel, was started to lead to a reservoir formed by what is known as the Gibralter dam. The south portal of this tunnel, which is 19,900 feet long and 9 feet by 6 feet in cross-section, is about seven miles from the heart of Santa Barbara. This tunnel also tapped a considerable flow of underground water, which is being used as part of the city's supply.

The project was carried out under the supervision of the Board of Water Commissioners, with Quinton, Code and Hill of Los Angeles as consulting engineers in charge of design and construction. E. E. Haskell was supervising engineer and Robert Westwick was assistant. Robert Craig was city manager of Santa Barbara. On July 8, 1918, a contract was entered into between the city and the Bent Brothers and W. A. Kraner for the construction of Gibralter dam and the appurtenant structures. This contract was completed and the work accepted on January 23, 1920. The work was completed in a little over eighteen months, during three months of which no work could be carried on because of the danger of floods. Mr. Kraner had supervision of the work, and M. H. Slocum and C. W. Hamilton were superintendents.

DESCRIPTION OF THE DAM

The Gibralter dam is of the arch gravity type, 1,100 feet long, 185 feet high from the lowest bed rock to the top of the outlet tower, which is 5 feet higher than the crest of the dam. The dam is curved to a radius of 239.5 feet on the center line. The width at the top is 8 feet and the maximum width at the bottom is 65 feet. The dam and spillway combined contain about 54,000 cubic yards of concrete. The depth of water to the spillway is 135 feet, and there is impounded behind the dam a lake about 4½ miles long containing about 16,000 acre-feet. With 10 feet of water flowing over the spillway, the highest recorded flood of the river can be more than provided for. However, 13 feet of water can pass over the spillway, which is 280 feet long at the crest, and slightly more than 300 feet long 13 feet above the crest.

The outlet tower forms an integral part of the dam. Water is conveyed from this through a 3 foot 6 inch reinforced concrete conduit about 200 feet long to a tunnel 900 feet long, from which it enters and flows through 1,600 feet of 3-foot reinforced concrete pipe to the north portal of the Mission tunnel. After flowing through the 19,900 feet of this tunnel the water is carried over most of the canyons on concrete trestles, although siphons are used in some instances. A pipe line, most of which is redwood stave, conveys the water to a distributing reservoir near the city. Along the line from Mission tunnel to the reservoir there is considerable fall, and the city proposed to utilize this for developing hydro-electric power in several of the canyons crossed. The entire development represents an investment of nearly $2,000,000.



GIBRALTER DAM, SANTA BARBARA WATER SUPPLY
Stores water of Santa Ynez river for the city supply.

CONSTRUCTION OF THE DAM

For construction purposes, an 18-inch gauge track was laid in the tunnel, on which electric locomotives hauled all equipment, supplies and men to and from the north portal. The small size of the tunnel and the attendant difficulties of transporting construction equipment governed, to a large extent, the type and size of equipment that the contractor could use. There was a trail for pack horses over the mountains, and a road by way of the San Marcos Pass, the last twelve miles of which was impassable to all but saddle horses. To put this road in shape and make it fit for use for bringing in contruction material meant a long and expensive delay, so the contractor determined on bringing all equipment and materials through the Mission tunnel, thus shortening the time of construction on Gibraltar dam about one year.

Two hundred and seventy thousand sacks of cement, 400,000 board-feet of lumber and all equipment, including a steam shovel, crushers, screens, cars, locomotives, hoists, cableways, concrete spouts, hoppers, etc., were successfully transported through the tunnel. The contractor exercised considerable ingenuity in the choosing of equipment. He had to be sure that the largest single piece of each machine could be taken through the tunnel. The major portion of the equipment was dismantled at the south portal and assembled at the site of the dam. It was necessary to follow the same process at the completion of the job, all equipment being dismantled and hauled through the bore and assembled at the contractor's yard in Santa Barbara.

Electric power was used for all construction and camp purposes, with the exception of the steam shovel, fuel oil for which was transported through the tunnel in a perfectly tight steel tank. Explosives were not allowed to be transported through the tunnel but were carried over the mountains with pack trains.

Rock and sand for the construction of the structures was obtained from the upstream side of the dam, being dug from the natural deposits by a steam shovel and loaded in 6-yard cars, which were hauled by a gasoline locomotive to the crushing and screening plant, which was located in the river bottom 200 feet upstream from the surface of the dam. After crushing, screening and washing, the aggregate was transported by electric hoist to bins on the hill above by two 1½-yard automatic dumping buckets running on two 1½-inch cables, one for sand and one for rock. Owing to high water prevailing during the winter months and covering the existing deposits of rock and sand, the contractor deemed it advisable to close the work down on December 15, 1918. Work was resumed on April 1, 1919, although concrete placing for the year did not start until May 15, 1919, owing to a delay in receiving some equipment. From this date concrete was placed continuously until completion

Cement was transported through the tunnel on cars carrying 50 sacks, and was delivered at a warehouse about 1,600 feet from the north portal. Before concreting started, there was a reserve supply of about 32,000 sacks of cement. After concreting had been started, the loaded cars were picked up just as they came through the tunnel by a cableway of 800 feet span, and set on a track at a landing platform at the head tower of the cableway. They were then let down by gravity to the mixer. The empty cars were brought back and sent down the cableway to the warehouse.

Concrete aggregates were measured in automatic measuring chutes and mixed in a one-cubic-yard mixer of the batch type, which dumped into a skip of 30 cubic feet capacity, which elevated the concrete in a tower the maximum height of which was 185 feet, from which it was dumped into hoppers and distributed in spouts.

The concrete tower was located as near the center of the structure as the topography of the site would permit, and the placing of the plant required much thought and careful planning. Owing to the sharp radius and the length of the dam, it was difficult to locate the tower and mixing plant so as to completely cover the work.

The contractor was particularly careful to secure alignment during the construction, the result being that at no place on the dam is variation from true line greater than one inch. The handling of concrete and the proportioning of the aggregates was carefully watched and the exterior surfaces are remarkably free from irregularities and voids.

Repainting an Old Steel Bridge*

Loose paint and dirt were removed by sand blast for 1 cent per square foot. Structure was repainted with 12 kinds of paint for different parts.

The paint on the structure was in very good condition, except as already detailed in regard to the upper work of the railway deck. It had been completely renewed three times in the preceding twenty-two years, with a 75 per cent home-mixed white lead, zinc and linseed oil paint. While no comprehensive method had been adopted in removing rust spots before applying the new coats of paint, the deterioration from rusting was practically nothing (except on the railway floor) on starting to clean the structure thoroughly with Mott sand-blast machines, and it was found that the original coats of red lead and white lead and zinc were intact over about 20 per cent of the 480,000 sq. ft. of surface. Therefore, the sand-blasting was only used to clean off all dirt, loose and dead paint, and thoroughly to burrow out the small rust spots. As soon as possible after cleaning, these rust spots were coated with Tockolith to kill any small amount of rust missed, or the starting of incipient rust. The machines used for the sand-blasting were two No. 1 Mott sand-blasting machines and one No. 2.

COST OF SAND BLASTING

When it was found that silica sand would cost more than $6 per ton delivered at the bridge from Illinois, several local sands were tried, and the dried locomotive sand procured from the Grand Trunk Railway roundhouse was found to be sharp enough to give the results desired. The maximum speed in cleaning reached as high as 25 to 30 sq. ft. of surface per minute, and the entire cost of the work, including labor, sand and power, was close to 1 cent per sq. ft., so that the average reached was only about one-tenth of the maximum possible, due to lost time in charging sand, changing nozzles, building and changing scaffolds, and all the usual delays in work of this character. The interference from other classes of work under way was also a big factor in reducing the efficiency of the cleaning, and it would seem easily possible on an ordinary bridge with no other work in progress to reach an average of 6 to 8 sq. ft. per minute. In any event, it proved to be the one best way properly and thoroughly to clean an old bridge. Improvements in the apparatus were made by reaming out a tapering entry for the sand in the inner ends of the loose nozzle tips, and by using bent nozzles for reaching surfaces that were difficult for the operator to get at, and for the inside of latticed members.

The carburetor on the machine should also be improved so as not to clog up with damp sand, as it was nearly impossible to keep the sand dry in only damp and foggy weather, while in wet weather work soon had to be practically suspended.

SELECTION OF PAINTS

The great variety of conditions on various parts of the structure required the use of twelve different kinds of coatings, each one for a specific purpose, as will be briefly described. They were red lead, white lead and zinc, Tockolith, graphite, Galvanum, cement paint, fireproof paint, turpentine asphaltum, Hermastic enamel, enamel primer, carbolineum, and cement gun coating.

The red lead was 60 per cent ready mixed, with asbestine and other suspension pigments. This was used for the shop assembling and first coat, but for the field 3 lb. of lamp black per bbl. was added to insure further the keeping of the red lead in suspension, to increase the spreading, and to darken it so the silver-gray lead paint would cover more easily. It was intended to use this for all metal fully exposed by the sand-blast as a first or spotting coat, but a study of conditions caused a change to Tockolith, as stated.

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*Excerpt from paper on Revision of Niagara Railway Arch Bridge by Charles Evan Fowler, presented to the American Society of Civil Engineers June 2.

The white lead silver-gray color paint was for the finish. It was 60 per cent white lead, 20 per cent zinc, and 20 per cent barytes and other pigments. The white lead and the zinc were each increased from 5 to 10 per cent in the field, so as thoroughly to cover the darker paints.

The Tockolith was substituted for the red lead to cover rust spots after cleaning, as the writer's experience for several years in painting badly rusted metals has shown that this paint absorbs the oxygen from rust and stops further rusting. The cutting apart of girders for reinforcing disclosed that where the surfaces had been painted with red lead between cover-plates and angles before shop assembling, all the paint had been practically burned out during riveting. Therefore, Tockolith was tried for much of the assembling paint in the field.

The use of Superior graphite was deemed necessary on the bottom of the copper-steel floor to resist drippings from salt water, acids, and gases. One coat was used for this purpose and the second coat was the white lead finish paint. Graphite is undoubtedly one of the few paints that should be used for assembling, so as not to be burnt out in rivet driving. Possibly better results would be had by substituting something, at least in part, for the linseed oil.

The Galvanum was used for painting a few hunfred square feet of galvanized corrugated-steel roofing between the girders at the toll offices. Ordinary paint could have been used by first washing the galvanizing with a weak muriatic acid solution, or by adding cut shellac to ordinary paint.

The cast-steel bases and boxed-in-bases of the viaduct columns were filled with waterproofed concrete, formed with the addition of Medusa compound. To exclude the water further and to match up with the silver-gray coat on the bridge, Acme cement paint was used for painting the exposed surfaces of this concrete.

The use of Acme fireproof paint for the timber floor was investigated by painting some boxes and attempting to burn them. The results were so satisfactory that it has been recommended that the cracks in the roadway and sidewalk floors be sprayed with this paint as soon as the lumber dries out in the spring, in order to prevent fires starting from cigarette and cigar butts.

The elbows and inclined sections of the 4-inch steel pipe downspouts were painted with turpentine asphaltum as a partial protection from salt water, since it was not possible under the conditions existing to use Hermastic enamel in this location.

The Hermastic enamel was used for coating the copper-steel drainage floor as a protection against the rusting or corrosion of the steel of the railway floor system due to salt water and other drippings. The copper-steel plates were also coated with this where they had a bearing on the maple risers, and in addition the maple was given a coat. The metal was first cleaned, then coated with the enamel primer, and the Hermastic enamel applied with special daubers, while the enamel was very hot. Even then it would only spread a distance of 12 to 18 inches. Owing principally to the thickness of the plates and the constant breeze or wind down the gorge, about 50 per cent excess of the enamel was used and the average thickness was more than one-quarter inch.

Carbolineum was used for all timber treating, and it was generally applied hot with a brush, but the blocks were dipped in the kettles where it was heated. From one-fourth to one-half of coal oil was added to increase the spreading and penetration of the carbolineum. The timbers treated were the spiking strips for the highway floor, the maple risers and blocks for the tie-risers, as well as the stop-waters and other minor timber details.

The concrete abutments and walls were simply painted with a cement mortar cream by the cement gun.

SAND BLAST MACHINES

The sand-blast machines were made by the Mott Sand Blast Company, of Brooklyn, N. Y., and as stated were three in number, the No. 1 size consuming 94 feet of free air per minute, and holding 500 pounds of sand, while the No. 2 size consumed 94 feet of free air per minute and held 1,000 pounds of sand. They consisted of a sand tank filled through a sieve at the top, and discharging through a conical bottom to the carburetor where the compressed air is introduced, all regulated by suitable valves. The discharge hose is of special heavy reinforced rubber, and carries a nozzle which has small hardened cast replaceable tips. These tips were those reamed out conically to allow freer discharge, and special bent nozzles were made to facilitate work which was often somewhat out of reach and partly inaccessible for the ordinary nozzle.

Battle Creek Water Works

Battle Creek, Michigan, obtains water through the municipal system which is operated by the Department of Public Works, W. W. Brigden being superintendent and engineer in charge of water works, sewers and other public utilities. To Mr. Brigden we are indebted for the following information concerning the system.

The works were constructed in 1887, water being taken from Goguac Lake, which has an area of about 360 acres and a maximum depth of 80 feet. Although this supply is excellent for commercial uses the citizens were not very well satisfied with it for potable purposes, and in 1914 another supply was obtained at a distance of between 4 and 5 miles from this lake, water being obtained from driven wells in the Marshall sandstone. This station, however, like the other, has a capacity of only about eight million gallons per day, which is not sufficient to provide for the heavy sprinkling done during the long-continued hot, dry weather in summer. But the capacity of the two stations combined has never been taxed to more than ¾ of its full possibilities. Because of the better quality of the well water, however, the city is about to make extensive additions to the well water plant sufficiently to double its capacity and make it unnecessary to pump from the lake. The well supply is excellent for a potable water, but has a hardness of about 230 parts per million—chiefly of the temporary variety—and deposits considerable scale in boilers and other heating apparatus. The lake supply gives practically no deposit unless the boilers are run beyond their rated capacity.

The combined plant is worth $1,300,000, but all of this has been paid for by its earnings except a little under $250,000. There are more than 8,000 consumers and there will soon be about 80 miles of pipe from 4 inches to 20 inches in diameter. The department has accumulated a surplus in the water fund of over $63,000, which, together with the excess earnings in 1920, will be expended for extending and improving the well water plant. The city owes nothing whatever on the water works plant except current bills. All of the two bond issues that were outstanding have been paid.

The water rates are from 4 cents to 13 cents per thousand gallons, practically all of the services being metered. "The water department has been operated as a non-partisan affair and to a large extent has been carried on in the same manner as a first class private corporation would conduct its business. It cannot be said that politics and personal favoritism have been absolutely eliminated, but it is the opinion of most of our citizens and those of other surrounding towns that Battle Creek has come as near to carrying on a proper business management of its water works as any city in or near the state of Michigan."

Pennsylvania Road Contracts

Contracts made by the state of Pennsylvania call for an aggregate of nearly 650 miles of road improvements, either completed or under way, costing $2,702,012. The greater part of the road contracted for during 1919 is of reinforced concrete type, the remaining mileage being divided among bituminous concrete, brick, sheet asphalt and plain concrete. 186.21 miles of reinforced concrete cost $21,558,111.65, making the average cost per mile $14,358.25.

Opposes Federal Highway Commission

Continuance of the present plan for development of good roads by joint appropriations by the government and the states was advocated before the senate post office committee by representatives of highway commissions of twelve states, including Alabama, North Carolina, Texas, Oklahoma, Missouri, Indiana, Iowa, Kansas, Nebraska, Minnesota, South Dakota and Vermont. They opposed the Townsend bill proposing creation of a federal highway commission.

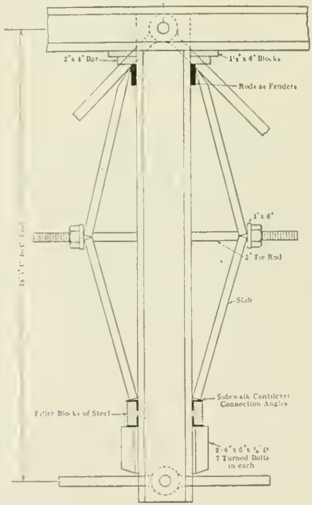
Alternate Plans Permitted by Specifications

The Indianapolis chapter of American Association of Engineers is vigorously discussing whether "engineering welfare may be promoted by encouraging open specifications for engineering desisgn, that is, the submission of alternate plans by bidders, subject to the approval of the engineer or architect in charge."

It is claimed that this would provide additional work for engineers; develop engineering qualifications in the bidder; produce better solutions; increase competition; eliminate the incompetent low bidder; improve efficiency and appearance of designs; encourage skilled construction; permit guarantee of construction; discourage pooling; relieve the engineer of suspicion; pay its own way by increased efficiency.

Avoiding Falsework in Bridge Repairs

In recent repairs to the railway arch bridge across the Niagara river, the consulting engineer, Chas. E. Fowler, found it necessary to reinforce the vertical posts in the 115-foot deck approach span which he accomplished in an ingenious manner described in a paper presented to the American Society of Civil Engineers June 2d. The method adopted, although applied to a railroad structure, is equally suitable for similar operations on a highway bridge and its adoption or modification for such purposes is likely to effect a considerable saving of time and expense over the alternative, which is generally employed, of supporting the structure on falsework during repairs.



TOGGLE RELIEVING VERTICAL POST OF BRIDGE TRUSSS FROM COMPRESSION

Shelf angles, already existing on opposite faces of the vertical posts at the lower ends, were reinforced by filler blocks and additional bolts and supported the lower end of a simple toggle made with four flat steel slabs and a screw ended tie-rod. The upper end of the toggle took bearing against steel plates that distributed the pressure on the top chord.

When the toggle was operated by screwing up the nuts on the tie-rod it developed vertical tension in the posts until the compression was eliminated; that is, the original stress in the post was transferred to the toggle, leaving the centre part of the post unstressed and permitting the reinforcement plates to be riveted to it in a proper manner.

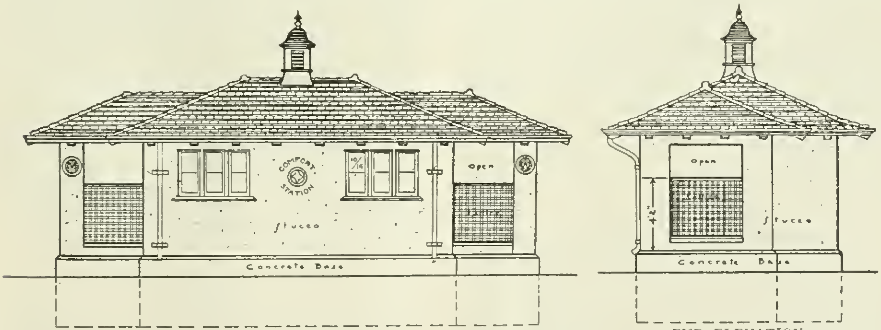
Public Comfort Station in Wisconsin

In conformity with a bill passed by the Legislature, the State Board of Health has issued rules and regulations governing the installing and maintaining of such stations by all incorporated communities of the state, and has suggested general plans and structural details.

A law passed by the legislature of Wisconsin in 1919 provides that "every city and incorporated village shall provide and maintain a sufficient number of suitable and adequate public comfort stations for both sexes. The State Board of Health shall establish rules and regulations governing the location, construction, equipment and maintenance of public comfort stations, and may prescribe minimum standards that shall be uniform throughout the state." This makes it mandatory for all cities and incorporated villages in Wisconsin to provide public comfort stations and for the board of health to establish rules and regulations concerning them.

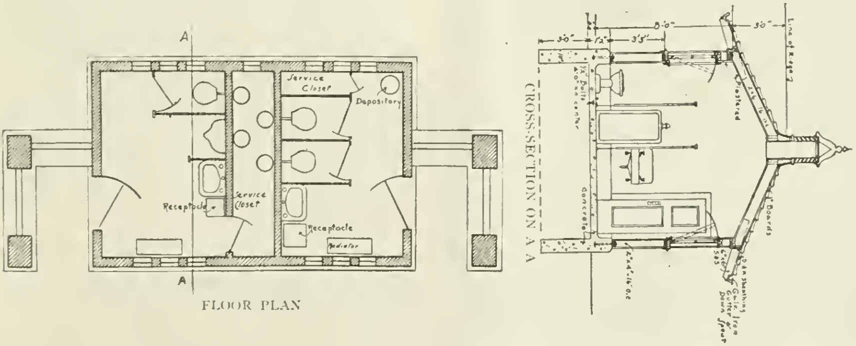
In conformity with this law, the State Board of Health has recently issued a set of rules and regulations governing the adequacy, location, equipment, maintenance, safety and sanitation of public comfort stations either to be built or already in existence in the State. These have been published in pamphlet form, accompanied by numerous sketches and suggested plans for such stations. The following points have been selected from this pamphlet.

It is suggested that public comfort stations may be located in public buildings. Also, that the development of the public comfort station movement will witness the establishment of many of such stations along public highways for the convenience of the traveling public. The board also suggests the granting of concessions such as telephone booths, parcel checking stands, vending and weighing machines, shoe shining stands, newspaper privileges, etc., to partially offset expense of operation.



REAR ELEVATION

END ELEVATION



FLOOR PLAN

CROSS-SECTION ON A A

COMFORT STATION, INDEPENDENT BUILDING TYPE.

The regulations are very complete and are divided into 78 sections. One of these requires that "before proceeding with the location, design and construction of a public comfort station or rest room, plans and specifications shall be submitted for approval to the State Board of Health." Other regulations specify the capacity, number and kinds of fixtures, construction of building, ventilation and lighting, construction of floors, walls, drains, etc. It is provided that every station shall display in a conspicuous position the standard public comfort station sign. This sign consists of a green circle five inches in diameter on the outside and one inch wide, with a white center in which is set a four-pointed, orange-colored star. This is placed on a white background with a border and lettering of a deep blue color. This emblem was designed by A. C. Shaver, plumbing inspector of Pasadena, Cal., was adopted by the American Society of Sanitary Engineering in 1912, and is now extensively used.

Considerable freedom is permitted in the design and construction of the building in which a public comfort station is to be housed, which may be of wood, brick, tile, cement blocks, concrete, stone, or similar materials.

It is provided that every public comfort station shall be open for use from sunrise to 10 p. m. every day of the week, and that the authorities shall appoint a responsible person who shall have charge of the station and visit it as frequently as is required, who shall be clothed with police power necessary for the proper fulfillment of his duties.

The sketches and plans show suggestive construction of simple buildings, pleasing in appearance, of various sizes, and also plans of details to facilitate construction of the stations by local contractors or municipal employes.

The pamphlet was prepared by the Plumbing and Domestic Sanitary Engineering Division, of which Frank R. King is engineer.

Classification and Compensation Proposed by Engineering Council

The Classification and Compensation Committee of Engineering Council, over the signatures of Arthur S. Tuttle, chairman, and Charles Whiting Baker, secretary, on June 9 addressed a letter to the secretaries of each of approximately 100 national or local engineering and other technical societies. Formal endorsement by the governing body or by the society as a whole of the classification adopted by Engineering Council is asked, to the end that it may become generally recognized and put into effect. As to the suitability of the scale of compensation and the employment policy tentatively suggested, the committee desires an expression of views both of the societies and of individual members thereof.

Through the medium of their society publications or some other convenient means, the secretaries are requested to urge the members to report to the committee any action taken to increase compensation or to adopt the standard classification. The committee proposes to act as a clearing house for receiving and giving out such information to any group of engineers for use in discussing these matters with authorities who have the responsibility for fixing compensation. "Through cooperative action," the committee states, "the effectiveness of the work done toward increasing compensation can be materially advanced."

To date several societies have taken action in regard to this matter. The Municipal Engineers of the City of New York on May 26, 1920, endorsed the classification and adopted a schedule providing for compensation at a rate approximately 20 per cent greater than that tentatively suggested by Engineering Council'c Committee. The classification has been closely followed by the Congressional Joint Commission on Reclassification of Salaries in its recommendations concerning engineers in the Federal service. It was approved on April 13, 1920, by the Executive Committee of the American Society for Testing Materials. The Boston Society of Civil Engineers made the endorsement of the tentative schedule of compensation the subject of a letter ballot by the full membership, which is now being canvassed. Thus it will be seen that substantial progress has been made in bringing about a recognition of Engineering Council's classification as *standard*.

The committee has been reorganized and is now made up as follows: Arthur S. Tuttle, chairman; deputy chief engineer, Board of Estimate and Apportionment, 1347 Municipal Building, New York; Charles Whiting Baker, secretary, consulting engineer, 31 Nassau street, New York; Frederick W. Cappelen, city engineer, City Hall, Minneapolis, Minn.; Philip P. Farley, consulting engineer, Borough Hall, Brooklyn, N. Y.; O. C. Merrill, chief engineer, Forest Service, Washington, D. C.; C. A. Morse, chief engineer, C. R. I. & P. R. R., LaSalle Street Station, Chicago, Ill.; M. M. O'Shaughnessy, city engineer, Ciiy Hall, San Francisco, Cal.; R. S. Parsons, general manager, Erie R. R., 50 Church street, New York; and Edmund I. Mitchell, assistant secretary, 29 West 39th street, New York.

Federal Public Works Department Referendum

In a recent referendum vote of the Chamber of Commerce of the United States, the majority of 826 against 549 were in favor of the establishment of a department of public works by the national governments, but failed to register the two-thirds majority required to carry it. The proposition for establishing a public works department by a modification of the existing Department of the Interior was lost by a vote of 675 to 679 and the proposition for establishing a department of public works by the creation of an entirely new department was lost by a vote of 282 against 992.

The Good Roads Bureau of the Chamber of Commerce of Little Rock, Arkansas, has filed a petition in a case now pending before the Arkansas Corporation Committee asking for reduced railroad freight rates on sand, gravel, crushed stone and other roadbuilding materials.

Operating a Mechanical Filtration Plant

Instructions and suggestions covering all ordinary features of coagulation, filtering, washing the filters and other details of operation are given by a manufacturer of filters. They should be of especial service to those with little experience in operating mechanical filters.

While it may perhaps be desirable to take with several grains of salt many of the statements made by the representatives of a firm when it is endeavoring to sell its appliances, its advice as to the operation of one which has been sold and installed can be relied upon as that of an expert whose aim is identical with that of the purchaser—to get the best result the appliance is capable of rendering. For good results are the best advertisement and are decidedly for the firm's interest.

For this reason we reprint the following from "Shop and Field News," published by the employees of the Pittsburgh Filter and Engineering Co. It is entitled "Hints on the Operation of a Mechanical Filtration Plant of the Gravity Type," and should be of especial value to the superintendent or other official who has not before had experience with such plants, but will probably contain some suggestions for those also who are not novices.

In placing the plant in operation be sure that all valves controlling the flow are properly closed. In starting to fill the sedimentation basin be sure that the chemical solution feed is started first. Make it a rule always to open the coagulant supply pipe before starting the pumps that pump water to a coagulant basin. A small amount of excess solution will do no harm, while to fail to do this may result in a considerable amount of water getting into the coagulating basin before coagulation is started. It is absolutely essential to secure coagulation before getting results.

COAGULATION

Regulation of the coagulant solution must be made in accordance with the conditions of the raw water supply and should vary probably from one grain or even less per gallon to possibly as high as five or six grains when the water is exceedingly turbid.

Judgment combined with the experience is the only way to determine the exact amount necessary to produce results.

The coagulation should appear in the form of a floc in the water, the floc taking the form of a distinct flake. This can be seen readily in the open basin with the sun shining upon the water; or have a clear glass available so that samples can be dipped from the basin and, when held up to the light, the distinct floc can be seen if the proper coagulation has been secured.

The greatest amount of the suspended matter should be precipitated in the settling basin, so that the water when applied to the filter bed is comparatively clear. This must be taken in a comparative sense only, for when the water is very turbid it, of course, will be somewhat muddy as it goes to the filter bed, but will be much clearer than the raw water.

At periods when the raw water is exceedingly clear it may be necessary to use a little larger amount of alum to secure a coagulation than when it has a certain amount of cloudiness or turbidity, for in the former case the blanket on the filter is formed entirely by the floculant matter.

In all cases, however, be sure that you have a distinct floc as the water goes to the filter bed.

There probably will be some conditions when it would be advisable to apply the coagulant at the baffle wall in the basin or various points in mixing chamber, rather than at the inlet chamber, on account of the small amount of turbidity the water contains. When it is extremely muddy, however, application should be made always at the inlet chamber.

If you do not secure proper coagulation there is some definite reason; either a sufficient amount of coagulant has not been applied or it may be possible that, in the event of continued rains and extremely heavy turbidity, the water does not have sufficient alkalinity to properly take care of the amount of aluminum applied.

In event of a difficulty in securing coagulation, immediately have tests for alkalinity made. Each grain of aluminum applied per gallon requires about .8 of a grain of alkalinity for its proper use, and there should at all times be a surplus of alkalinity of possibly a grain and a half over that required for the coagulant.

In the possible event of a deficiency in alkalinity, temporary application of a solution of either lime or soda ash, sufficient to make it up, may be applied. Your chemist can advise you of the amount necessary after making his alkalinity test.

While it is not probable that this will occur in the water, it is a possibility, so be sure to have on hand an ample supply of coagulant, always anticipating your needs of this material so that there is no possibility of your having to operate without proper coagulation, as without it results cannot be obtained.

FILTERING

After having filled the coagulating basin with the raw water properly mixed with the coagulating solution as it passes through the mixing chamber, open the valve supplying the influent to the filter bed, allowing the water to flow into the bed through the troughs on to the sand bed.

This should be done slowly so as not to get the bed air bound by flooding the surface and trapping the air in the sand. After slowly filling the filter box and allowing the water to rise to the level of the coagulating basin, open the filter waste for a few moments and let the first filtered water pass to the sewer, then open the filtered water or effluent valve and close the filter waste valve to the sewer and the filter plant is in operation.

WASHING

The filters should be kept in operation until the loss-of-head gauges show a loss of head of approximately ten feet, at which time it will be found that the amount of water passing through the filters will be considerably less than the normal rated capacity, which should be about two gallons per square foot of area. When the capacities decrease below this quantity, then it is an indication that the beds are in such condition, due to accumulation or deposits on the surface of the sand bed, and that they require washing. It will be found, on the average, that this will take place when the loss-of-head gauge shows a loss of head of ten, and in some cases as high as twelve feet, at which time the filter should be shut down and properly washed.

In doing this, close the influent valve and allow the water to filter down until within two or three inches of the top of the sand bed; then close the effluent valve and open up the sewer valve; next open up the wash valve, letting the wash water under pressure into the under-drain system. The pressure applied to the under-drain system for washing should be approximately ten to twelve pounds per square inch, equivalent to a head of twenty-five or thirty feet, which is ample for proper washing. Too great a pressure will disturb the gravel and result in the sand drifting down to the gravel bed and into the under-drain system, gradually clogging it up.

The wash-water valve should be opened slowly, so as to get the pressure thoroughly distributed over the sand bed and permit the sand bed to rise evenly over its entire surface for several inches; then, as the pressure increases due to the opening of the valve, the sand will separate and break up, and as the valve is opened to its full capacity the velocity of the wash water increases, carrying with it the accumulated suspended matter and separating the sand grains and scouring them thoroughly, carrying the accumulated matter away with the wash water into the wash troughs and thence to the sewer.

The process of washing under ordinary conditions will require from six to twelve minutes, depending upon the condition of the bed. In closing off the wash water, it should be done gradually so that the sand will settle in regular grades according to the size, and the surface will be smooth and level at the end of the wash. No definite time can be given for washing, as it will depend upon the appearance of the wash water as to when sufficient wash will have been applied.

In this connection it is well to note that when a filter plant is first put in operation, the sand should be washed more frequently, and the washing should be of longer duration than later on when the plant is in normal operation and the sand bed is in perfect condition. It is necessary to scrape the very fine sand off the surface two, and sometimes, three times in order to get the right grade of sand left and get rid of the very fine sand. This is usually done by the erector, but it may be necessary to scrape it again later on. This very fine sand will wash up to the top of the bed and will appear almost as a mud layer, but is easily distinguished after the washing operation has been completed. If allowed to remain in the beds, it results in extremely short runs, but of course is of no particular disadvantage otherwise, as the spaces below the sand grains are so extremely fine that they quickly fill up with deposits.

After completing the washing operation, the wash water pressure is closed off and the sewer valve is next closed. The influent valve supplying the treated water is opened and the filter allowed to fill up, then the rewash connecting to the sewer is opened for a few moments and the first water allowed to waste; this should take place in from ten to fifteen minutes; it is then closed and the effluent valve to the clear well is opened and the filter is in regular operation.

GENERAL

This in a general way covers the operation for mechanical parts of the operation of a filter plant. Actual results must naturally depend on observation and experience of the operator, as difference in conditions of water will necessitate different methods of treatment and handling. This means sedimentation, process of washing and the handling of the filters generally. The operator should take particular care to note the condition of the sand bed at all times and from the first evidence of any formation of any hard spots in the bed, use extremely long washing and thoroughly break up these spots with a garden rake or some other means; for if not taken care of immediately they will gradually grow larger and in time put a considerable portion of the bed out of commission, while if taken care of immediately they can readily be broken up and avoided.

They are due primarily to improper washing conditions, and this is one of the most vital points to watch in the operation of a filter plant if continued good results are desired.

The operator should take particular care to keep controllers properly adjusted and in proper operating conditions at all times, also all gauges and operating parts, in order that he may have a correct indication of what is going on in the operation of the plant. In the event of any part becoming broken, do not delay but have it repaired immediately so that it is always in shape to perform its intended function. Do not pass more water through the filter than it is designed or intended to purify except in the case of an extreme emergency.

Carefully observe the results of different treatments of the water at different stages and under different conditions so that you can form an idea of what treatment will give the most satisfactory result for each condition.

The city of Elmira, New York, having operated its own water system for five years, reports a gain during this period of $252,177.68. During the past year the net income of the water board amounted to $54,341.29.

Another notable fact is the reduction of rates during this time, about $16,000 being saved to water users in the last three years. The plant has been increased $137,000 in value by additions and improvements, thirteen miles of mains having been laid.

Chicago's Street Railway Trailers

The first of Chicago's new trailer cars has made its appearance on the tracks of the Chicago surface lines. The car is so light that no motor was required to move it, the workmen pushing it easily out of the shop.

It is completely encircled by windows, so that it should afford cool transportation during the summer. It will seat sixty-two passengers, compared to the capacity of forty-eight of the motor car which will draw it, Chicagoan's present mode of travel. The trailer weighs less than half as much as the motor car.

It is believed that the trailer will clear the streets of waiting passengers and eliminate the discomfort of strap hangers during rushs hours. If it meets the required standard of efficiency a large percentage of the 200 additional cars to be ordered by the Public Utilities Commission will be trailers.

Boston's High Pressure Water System

A high-pressure water system that will eliminate the fire engine from the streets of downtown Boston, only hose trucks being used, is assured early operation by the signing of contracts for three pumping stations. The high-pressure pipe already laid aggregates 9.3 miles, and when completed the system will include more than 18 miles of pipe.

It is expected that 12,000 gallons will be forced through this pipe a minute at 300 pounds pressure, or approximately 18,000 gallons at the more practical pressure of 200 pounds, from four pumping stations to be operated this year. Eventually three additional pumping units will increase the volume of water to 36 000 gallons at 200 pounds pressure.

Water will be drawn from three sources—from the domestic low pressure system, high pressure feeds, and salt water from the harbor. The system, construction on which began eight years ago, will have cost between three and four million dollars when completed.

Dublin's Concrete Quay

The largest concrete blocks ever laid are said to be those used in the construction of the north quay extension of the port of Dublin, each block containing more than 5,000 cubic feet and weighing about 350 tons. By their use it was possible to build the extension quay without costly cofferdams or extensive pumping. The blocks were made above high water level. When sufficiently set, they were lifted by a floating crane and deposited on a bed prepared by steam dredging, after which they were leveled by men working in a large diving bell, entered through a tube fitted with an air lock. Large concrete blocks were similarly placed for breakwater protection and for the foundation of one of the lighthouses at the harbor entrance.

Jamaica Bay Terminal

A. H. Greely, of Cleveland, has made an offer to build terminal facilities on Jamaica bay, New York, involving an expenditure of $100,000,000, without any expense to the city of New York, provided the contemplated deepening and widening of the interior channel of the bay is carried out. The Board of Estimate has appointed a committee to investigate the proposition. As yet nothing has been heard from Washington regarding the status of the bill providing for a 30-foot channel in the bay.

National Park-to-Park Highway

A. L. Westgard, field representative of the American Automobile Association, has joined an expedition of westerners who intend to lay out a national park-to-park highway passing through seven states. Once a circuit is decided upon, there will come immediate effort to improve the roads all along the line through federal, state and county co-operation. After this preliminary trip, there will take place an official tour, starting from Denver August 25. That party will occupy some sixty days in visiting the national parks, monuments and other attractions. It is believed that if the scenic attractions in the states west of the Mississippi are connected by real roads, many citizens from the east will visit the eleven national parkways to be linked up.

Necessary Legislation

U. S. Senate Interstate Commerce Committee has ordered favorable report on Poindexter Bill which would make a felony of any proven intent to obstruct or prevent movements of commodities in interstate commerce by persuading persons to quit work or by destroying property and would provide for punishment of persons who, through violence or threats, prevent employees from continuing work; anti-strike provision of the Railroad Bill, as added to Poindexter measure, would prohibit two or more persons from conspiring to bring about a strike that would tie up interstate commerce.

Federal Water Power Bill

The bill which releases the water power of the nation to private development has been passed after long controversy. The Secretary of War, the Secretary of the Interior and the Secretary of Agriculture will constitute a commission which will say what sites may be developed, whether the erection of dams would interfere with the present navigability of rivers, and what the companies shall pay the government. At the end of fifty years the private companies are obliged, if the government wants the property, to sell their rights.

It is intended by this bill to make available the power for industrial development not merely in the manufacturing centers of the east, but in all parts of the west where, hitherto, the long haul for coal from eastern mines has made the building of factories out of the question. It will probably be two years before the full effect of the measure is felt.

A new New York state law restricts trucks and trailers operating outside of cities to a width of 8 feets, height of 12 feet 6 inches, and total weight of 25,000 pounds.

Electric Pumping in Concord

Electrically driven centrifugal pump, installed last year, used an average of 525.5 kilowatt-hours per million gallons pumped, compared with 1840 pounds of coal used by the steam pump. The change to electricity permits running the plant with one man instead of two.

Concord, N. H., population about 22,000, has owned a water supply since 1872. The supply comes from Penacook Lake by gravity, but is pumped to a reservoir for high service and fire protection. This pumping was formerly done by a steam plant comprising two 2,000,000 gallon triple-expansion Worthington pumps, operating against a head of 90 feet static or 108 feet dynamic, with an average duty last year of 48,550,000 foot-pounds on a coal basis.

An electrically-driven centrifugal pump built by the Worthington Pump and Machinery Corporation was installed in the pumping station last year. This is driven by a 100 h.p., a.c., General Electric motor.

The pump is an 8-inch type "B S" slow speed, horizontally split casing, volute centrifugal pump, and was guaranteed to pump 2,100 gallons per minute against a head of 125 feet and to have an efficiency of 72 per cent, approximately, when operated by a 100 h.p. motor running at a speed of 1,800 r.p.m. The power, supplied by the Concord Electric Co., is alternating current, 2,200 volts, 3 phase, 60 cycle.

The pressure on the suction end of pump when not running is fifty pounds, and on the discharge end eighty-seven pounds. When the pump is started the pressure on the suction drops and that on the discharge end rises, making the average net head pumped against of 122 feet.

The capacity of the pump when running at 1,800 r.p.m. against this head is 2,570 gallons per minute by Venturi meter measurement, and the efficiency is 83.9 per cent figuring the motor efficiency at 90 per cent and switchboard at 98 per cent.

The two steam pumps will be kept in good condition and used for emergency work.

All pumping by electricity is done at night at hours regulated by the Concord Electric Co., but in case of fire or other emergency the pump may be operated during the daytime.

The superintendent of the plant, P. R. Sanders,

Engine Record—Steam Pumps.

MONTH..	No. days pumping engine No. 1.	No. days pumping engine No. 2.	Total days pumping.	Total hours pumping.	Average time pumping.	Total gallons of water pumped.	Daily average pumped.	Total coal consumed.	Daily average coal consumed.	Total pounds of wood consumed.	Gallons pumped per pound of coal.
				H. M.	H. M.						
January	16	15	26	271:30	8:44	24,246,155	782,134	44,033	1,420	1,293	556
February	13	15	24	248:	8:51	22,563,427	805,836	41,940	1,497	1,292	537
March	12	20	26	263:	8:29	24,446,057	788,582	46,598	1,503	1,001	524
April	16	14	22	233:30	7:46	20,442,721	681,424	39,049	1,301	1,273	523
May	20	25	26	347:	11:21	30,966,687	998,925	57,176	1,844	912	541
June	9	26	26	312:30	10:25	28,824,428	960,814	51,703	1,723	973	557
July	6	27	27	285:	9:11	26,405,749	851,798	47,196	1,748	1,288	559
August	8	1	7	74:	9:15	6,844,133	855,516	11,975	1,446	312	571
September	..	..	..	......	....	....	....	......	.....	.....	...
October	..	..	..	......	....	....	....	......	.....	.....	...
November	1	1	2	6:45	3:23	619,768	345,884	1,442	721	.....	479
December	..	..	..	......	....	....	....	......	.....	.....	...
Total	101	114	186	2,401:15	....	1 85,359,125	....	341,112	.....	8,344	539
Daily Average	..	...	...	......	10:10	889,027	....	1,823	.....	.....	...

Record of Motor Driven Centrifugal Pump.

	Total days pumping.	Total hours pumping.	Average hours pumping.	K. W. H. monthly.	Daily Average K. W. H.	K. W. H. per 1,000,000 gallons	Total gallons pumped Venturi meter.	Oil.	Packing.	Waste.	Coal heating.
		H. M.	H. M.								
August	22	103:20	4:29	7,560	320	462	16,318,000	1 pt.	½ lb.	1½ lbs.	....
September ..	30	128.10	4:13	10,350	340	527	19,631,000	2 "	1½ "	3 "	396 lbs.
October	31	151:10	4:52	11,210	360	526	22,328,000	2½ "	2 "	3 "	3,150 "
November ..	30	125:45	4:11	10,360	340	524	19,725,000	3 "	2 "	2 "	3,441 "
December ...	31	152:20	5:25	12,840	410	525	24,421,000	4 "	2½ "	2½ "	5,704 "
Total ...	144	660:45	....	52,320	...	...	102,423,000	12½ "	8½ "	12 "	12,691 "
Daily average ..		......	4:35	......	36C	525.5	711,270	....	....	....	100.8 "

in his annual report for 1919, says that the change from steam to electricity has enabled them to run the plant with but one man, transferring the fireman to inspection work and other duties. As it would not be economical to keep fires under the boilers for the purpose of heating the station, a small heater was installed, in which 12,691 pounds of coal was burned during the last four months of the year.

The accompanying tables show that during the first seven months of last year the steam pumps lifted 539 gallons per pound of coal (or used 1,840 pounds per million gallons pumped), pumping an average of ten hours and ten minutes a day; and that the motor-driven centrifugal pump, during the last five months, used an average of 525.5 kw.h. per million gallons pumped, operating an average of four hours and thirty-five minutes per day. (The fact that the electric pump operated less than half as long per day as the steam pump probably accounts for the fact that the dynamic head was fourteen feet greater for the former than for the latter.)

The Bayonne Submerged Water Main*

Laying 3,600 feet of 30-inch cast iron pipe with flexible ball and socket joints across the Hackensack River. Pipe assembled in a concave cradle 96 feet long supported between two scows gradually moved across the river to deposit the pipe in a dredged trench 40 feet wide.

The water supply for the city of Bayonne, New Jersey, is derived through a pair of 30-inch cast iron pipes which, for the 1,800 feet length of the Hackensack river crossing, are provided with ball and socket joints and laid side by side, 20 feet apart on centres, in a trench 40 feet wide which was excavated to a maximum depth of 32 feet below low water with slopes of 10 to 1 and 4 to 1. About 100,000 yards of sand, clay and mud were excavated in making the trench, which was finished with sand and clay to a reasonably smooth surface.

A wooden cradle was made in eight 12-foot sections, consisting of a pair of continuous trusses, braced together 16 feet apart and supporting between them a 2-foot 6-inch track curved to the arc of a vertical circle of 86 feet radius. The cradle, with the lower end supported on the bottom of the trench, was swung from a transverse timber connecting the tops of the derrick towers on the two scows. The scows were anchored with the centre line of the cradle aligned with rangers on shore in the axis of the dredged trench.

At the commencement of operations three lengths of pipe were assembled in the lower end of the cradle, and their joints were poured and calked and they were anchored at the shore end, the upper end having been temporarily elevated high above the surface of the water. As additional lengths of pipe were assembled in, and lashed to the upper end of the cradle, this was lowered and the scows advanced until the top of the cradle was at the proper elevation, after which the lashings were cut and the pipe was allowed to slide off from the cradle as additional lengths were assembled and the scows moved forward.

When the first line of pipe had been nearly completed the cradle was removed by combined longitudinal and transverse motions. This overstrained the pipe, which sprung a leak, and required recalking. After recalking, the last three lengths were suspended from one derrick scow and the remaining lengths laid from the other scow. When the laying of the second line had been completed, the cradle was unbolted in the middle and taken out in two pieces without disturbing the pipe. The joints required about 155 pounds of lead each and were inspected from the inside by lowering a man from the cradle end.

The pipe was tested up to 108 pounds and developed no important leaks. It was found easily possible to repair leaks from the inside, but this took about 100 pounds of lead for each leak, and was such a slow operation that it was more profitable to repair them from the exterior with divers when two or three leaks appeared. The pipe was covered with sand three feet deep, deposited from a derrick scow equipped with a hopper and telescope pipe, enabling it to be operated with great accuracy. The pipe was laid at an average rate of about 7½ lengths and a maximum rate of 18 lengths per day, by a force consisting of 3 calkers, 3 riggers, 3 engineers and 4 laborers.

The bell ends of the joints were reinforced by steel tires shrunk on, and the spherical surface was machined to an accuracy of 1-32 inch. Great care was taken in handling the pipe to prevent scarring the balls and any sand holes or defects which passed inspection at the foundry were repaired by boring small holes, larger at the bottom than top, and filling them with Babbitt metal.

The work was executed by the Snare & Triest Company as contractor, under the direction of M. R. Sherrerd, consulting engineer.

Predecessors of Chicago's New Bascule

Chicago's new bridge connecting the northern and southern parts of the city, is the ninth successive river link established at this site. The first recorded means of transportation was a canoe. This was followed by a rope ferry, which in turn was succeeded by a floating bridge, hinged to the bank. When the latter, in 1852, swamped while being drawn in to allow a ship to pass, the settlers returned to the rope ferry, until this in turn met with an accident, being fouled by a ship and causing the death of several people. The next venture, a swinging bridge of wood and iron, costing $54,000, collapsed in 1863, when a substitute bridge tender attempted to swing it while 150 head of cattle were crossing. A wooden bridge was next errected and lasted until the fire of 1871. A steel bridge, costing $115,500, was used twelve years before coming to grief when several ships attempted to pass through the south draw at one time. The bridge succeeding this one still stands, but will be torn down this summer.

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*Abstract of paper by F. H. Sherrerd, published in Journal of American Water Works Association, May, 1920.

The new bridge is a double deck bascule. When the draw is opened for passing ships the two "leaves" rise 150 feet into the air. A broad boulevard leading to the upper level is reserved for pleasure vehicles, while the lower passageway is used by trucks and drays. More than twenty years were spent in planning the construction of this bridge, whose cost approximates $16,000,000.

Cumberland Valley Railroad Bridge

The new bridge carrying the Cumberland Valley Railroad across the Susquehanna river at Harrisburg has 14 concrete arch spans of 74½ and 77 feet and clear length between piers and was built by the Robert Grace Contracting Company of Pittsburgh.

For construction purposes, a pile trestle was built alongside the bridge and on it was installed a service track for the delivery of materials and for handling plant and equipment. This track was about 10 or 12 feet above ordinary water level and nearly 40 feet below the top of the parapet.

Concrete was mixed on shore and delivered over the service track for both piers and superstructure. One half of the piers, being substantially duplicate, were concreted in Blaw riveted steel forms, shifted from pier to pier as the work advanced.

For the construction of the arch spans, several sets of riveted steel arch center trusses were fabricated by the Blaw Company (now Blaw-Knox Company) and were shifted from span to span and used over and over again so as to secure maximum rapidity and minimum total cost, superior to what it was estimated would be afforded by the use of wooden centering.

The arch trusses were all made to fit the 74½ foot spans. Each consisted of two segmental semi-trusses with curved top chords and inclined shraight bottom chords, connected together at the crown and by a horizontal tension member at the second panel point from the lower ends of the bottom chords.

These trusses were braced together in sets of four and to the top chords was attached the transverse wooden lagging on which were built the wooden forms for the arch ring. The lower ends or skewbacks of the arch trusses were adjustably supported on transverse timber sills set close to the face of the upper part of the piers.

After the concrete in the arches was sufficiently set, the arch center trusses were lowered to bearing on rollers and were pushed transversely from under the bridge, on to supports on trucks spotted opposite to them on the service track; after which these trucks were pushed forward by a locomotive crane to the required position between piers in advance, while the operations were reversed, and the sets of trusses, together with the lagging connecting their top chords, were moved into position between the piers and adjusted to receive the concrete for the arch in that place, and so on, until the last span was completed.

Adjustment was made to fit the intrados of the 77-foot spans by driving thin wooden blocks between the flanges of the top chords of the arch trusses and the nailing strips to which the lagging was spiked.

The semi-arch trusses were assembled at the site and erected in position by the locomotive crane, which also handled the heavy steel forms for the piers and the wooden forms for the spandrel walls and buttresses.

The locomotive crane also handled the buckets of concrete from the service track to the forms and, in order to swing over the top of the spandrel wall, it was equipped with a special boom having a straight lower portion about 50 feet long, extended by a piece about 15 feet long spliced to its extremity at an angle, and guyed at the splice by back stays to the bed of the crane. When the lower part of the boom was topped up to a nearly vertical position, it could be swung close to the face of the spandrel wall and allow the inclined upper end to project over the roadway, which could not have been accomplished with a straight boom of practicable length operated from the service track.

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*See illustration on front cover.

Revised Freight Rates for Construction Materials

There are now before the Interstate Commerce Commission, applications for permission to increase railroad freight charges. If these applications are granted, the changes in carriage should be so formulated as to correct the inequalities and discriminations against construction materials that have developed since 1914.

In order to present the case in favor of construction interests most clearly, the National Federation of Construction Industries, Rexall Building, Philadelphia, has issued a circular letter requesting all associations that wish to present arguments to the commission in a forthcoming hearing, to immediately obtain data showing the inequalities in freight rates which now obtain with commodities in which they are interested. They are therefore desired to communicate immediately with the federation and state if they desire to participate in the hearing for which the federation has petitioned.

After reciting some of the adverse conditions under which the construction industries have suffered, the federation, under date of June 10th, has petitioned that, should the commission decide to grant the applications of the carriers for increased revenues through increased freight rates, but before such schedule is made effective, the commission should arrange for the federation and such of its constituent associations as may desire to be heard, to present to the commission their data and arguments relative to the transportation cost to be placed upon their respective construction materials.

In order to cooperate with the senate special committee on reconstruction and production, the federation has appointed a special committee composed of B. F. Affleck, Chicago; Philip Gadsden, Philadelphia, Pa.; John L. Kaul, Birmingham, Ala.; Charles F. Lang, Cleveland, O.; Gen. R. C. Marshall, Jr., Washington, D. C.; W. T. Rossiter, Cleveland, O.; J. Willison Smith, Philadelphia, Pa.; and Robert C. Wright, Philadelphia, Pa.

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Highway Work Potsponed

At least five states have decided to attempt no new highway work this year. in spite of the millions of dollars which are availabel for such work. Both these and other states have advertised such work amounting to hundreds of millions of dollars, but part of it received no bidders, and for other parts the bids were considered too high to warrant acceptance. Many contracts which have been let are lagging or have been stopped completely because of inability of the contractors to preform the work.

The outlook for a large mileage ot highway construction this year is very poor at present.

In discussing this from the contractor's point of view W. A. Rogers, president of the Associated General Contractors of America, attributes this unsatisfactory condition largely to three factors—transportation, material prices, and scarcity and inefficiency of labor.

Several large contracts in the vicinity of New York have been discontinued for several weeks, because of the inability of the contractors to obtain cement. asphalt and other materials. In these and some other instances, at least, neither labor nor high prices have interfered with performing the work, although they have undoubtedly greatly reduced the amount which has been undertaken.

It would appear therefore that the most urgent need is for better transportation service by the railroads. Just how this can be attained or where lies the blame for the grossly inadequate service is difficult to say. The different ones on whom the blame is placed from time to time invariably "pass the buck". The railroads say that they have only half enough freight cars and that, unless they can obtain a much larger income by increase of rates, it will be impossible for them to increase their equipment. It would seem as though a reply to this might be made that, if they would increase their equipment, they could easily double their income at the present rates by carrying double the amount of freight, which is appealing for transportation.

There is a suspicion that the railroads are at least making no great effort to remedy this transportation crisis, in the hope that such crisis will influence the Interstate Commerce Commission to permit them to increase the rates. Also, it is suggested that the present equipment could be used much more effectively and by it much more freight could be handled if the railroad employees in yards and terminals (and possibly elsewhere) were increased in number, their ranks having been considerably depleted by the strike of a few weeks ago. Here again the theory is advanced that the railroads are not making any great effort to replace the vacationists, on the theory that the greater they can make the discomfort of the people through traffic insufficiency, the more promptly and fully will the Traffic Commission yield to their demands for increased rates.

Inefficient Transportation

The Associated General Contractors have pust sent out a questionnaire to its members with a view to urging upon the Interstate Commerce Commission that priority be given to construction materials over all other commodities except food and fuel. "Under the present rulings, construction materials are forced to compete with luxuries and the least essential commodities for transportation service." With a view to securing exact data for enforcing the arguments of the association, secretary G. W. Buchholz asks each contractor to send to his office information concerning any work delayed on account of car shortage, with the approximate value of each contract, what types of cars are needed, how many daily, and points of shipment and delivery, and what percentage of their requirements for cars have been received during the previous ten days.

Other pleas for the granting of perference to materials for highway construction are that the very fact of the overloading of the railroads, is a strong argument in favor of highway construction, since trucking on the highways would supplement the short-haul business of the railroads.

Contractors of course are not the only sufferers by this condition. The paving brick manufactures have issued a statement that they find it impossible to ship paving brick; that the yards are becoming overstocked with brick which, whether ordered or not, cannot be shipped out; and that, unless the condition improves at once, many plants will have to shut down, and both paving brick and the brick paving industries will suffer severely.

Whatever the cause and whatever the remedy, there can be no dispute that there is a serious crisis in the transportation system of the country, and all who are in any way able to advance in any degree the improvement of the service should consider it their patriotic duty to do so.

Labor Scarcity

As to labor, there is still a scarcity ot that, although immigrants are coming in greater numbers than was the case a few months ago. There is still a considerable shortage in many sections of the country, however, and if the transportation situation should improve so that materials could be available for the large amounts of work that are awaiting prosecution, the labor problem will undoubtedly come to the fore as very serious.

The idea of introducing Chinese labor is still being urged, especially for the Middle and Far West.

A number of California contractors have informed us that they are heartily in favor of introducing such labor into this country under certain conditions. One of them states that he is in favor of it, providing laws be passed prohibiting Asiatics from obtaining citizenship or owning or leasing land, this contractor being also a farmer and having found that the Chinese use a form of sabotage for discouraging farm proprietors and acquiring their land.

One cause of labor shortage is the fact that many of the laborers now in the country refuse to work, for one cause or another. The high wages which have been received during the past year have enabled many of them to remain out of employment for longer periods than would otherwise be the case, in their effort to secure higher wages, shorter working hours, recognition of the union, or other demands through the weapon of the strike. Add to this the fact that in many lines of work the hours have been shortened and the efficiency lessened because of this feeling of independence, and the labor problem is seen to be a very real one. One thing is certain, when the transportation situation improves, the labor shortage will take its place as the most serious matter confronting the people.

Protect the Strike-Breakers

If the New York strikers make, as there has been reason to fear they will, violent efforts to prevent the operation of the citizens' transportation committee's trucks that have been provided by the $5,000,000 fund to maintain commerce here, any disorder should be instantly and vigorously repressed by the police; and if, as in previous times, they prove unwilling or inefficient, Governor Smith should be prepared to immediately follow the example of Governor Hobby of Texas, who ordered 23 troops of dismounted cavalry and 3 machine gun companies to the Galveston docks to protect labor and property from the strikes there.

To Increase Construction Transportation Facilities

The recent and present delays and inadequacies of railroad transportation facilities have brought about priority rulings by the Interstate Commerce Commission which discriminate against construction materials, virtually putting the latter in competition with luxuries and less essential commodities. As a result, construction is in many localities already nearly paralyzed and, in order to help it, the Associated General Contractors of America has issued a questionnaire, the answers from which will be referred to the authorities at Washington with the hope of securing some recognition of the right of construction materials to transportation subordinate only to food and fuel.

This action is likely to have considerable weight with the Commerce Commission and it is desirable for contractors, builders, dealers, owners, engineers, architects and others that are interested and who are in possession of authoritative data, should fill out the questionnaire and forward it, whether or not they are members of the association.

QUESTIONNAIRE

Recognizing that the shortage of transportation facilities is acute, and assuming that food and fuel must be given preference in order to feed the country and maintain industry—

Do you favor an effort on the part of the A. G. C. to secure priority for construction materials over less essential commodities?

What conditions or facts in your locality prove the need for giving construction materials preference above all other commodities other than food and fuel?

Is your work being delayed on account of car shortage? Please give actual contracts with approximate value.

What type of cars are needed? How many daily? Where?

Point of shipment

Railroads

Point of Delivery

Open top No. daily

Box cars No. daily

What percentage of cars as compared with your requirements have you received in past ten days?

Remarks:

Beverly R. Value

Beverly R. Value, president of the General Contractors' Association of New York, died in New York City, June 10, at the age of 57. He was a member of the class of '84 in the Columbia School of Mines, and successively served on the engineering staff of the New York Aqueduct Commission, the construction of the new Croton dam, as division engineer on subway construction for the New York City Rapid Transit Commission, as chief engineer of the Electrical Development Company and construction of the Hydro Electric Plant at Niagara Falls, and of the famous McCalls' Ferry Power Company and for a similar plant on the Susquehanna River, and for the past 12 years has been chief engineer, comptroller and director of A. S. Kerbaugh, Inc., the Empire Engineering Corporation, and the Kerbaugh-Empire Company, and has been secretary, treasurer and director of Geo. W. Rogers & Company. He was an able executive, had great experience on heavy construction work, and was particularly successful in the selection, installation and operation of heavy plant and equipment.

Sound Labor Union Advice

In an address at Manchester, N. H., May 17, before the consolidated labor organizations of that city, Grenville S. MacFarlane, of Boston, declared that "In America many of your national labor organizations have degenerated into political machines quite incapable of real political power to the workmen, but quite invincible in keeping some labor leaders in office without convincing reasons for their continuance in power."

"While the leaders are acknowledged and are given the power to make contracts, those contracts ought to be honored. The way to change leadership and repudiate it is not to repudiate honorable obligations with the third parties."

Mechanical Equipment for Highway Construction I.

The author describes various appliances and uses of them for unloading aggregate from cars, for bringing it to the mixer, and for mixing it

With larger amounts of money becoming available for highway construction, there is coming to be a demand for the construction of highways by miles instead of by feet. In Illinois in the past the average mileage completed per construction unit has been less than three miles per working season, and this experience was apparently borne out again in 1919. This condition is general throughout the country, and it does not apply to Illinois alone.

Many contractors have been able to place seven miles of road per season using small equipment, and G. P. Scharl, with large equipment, placed fourteen miles last year. However, these are exceptional performances. Two causes are responsible for the low average. First, the contracts have in the past been awarded so late in the season that there has been no possibility for the contractor to complete his work the first year; and, second, both contractors and engineers have thought in terms of square yards instead of in terms of miles of completed work. But there is available for highway construction work in 1920 approximately six hundred and fifty million dollars, almost three times as much money as was available for 1919 and five times as much as has been available in any other year. Construction men are, therefore, face to face with development of organizations and methods which will allow the expenditure of this money both economically and rapidly.

While this demand was materializing, laboratory investigations showed that uniformity of concrete throughout the paving slab was essential and that to get this uniformity it was desirable to hold the concrete in the drum of the mixer for at least one minute. Whereas the contractor had previously expected to turn out from fifty to sixty batches per hour, depending on his ability to charge the mixer, he was now cut down to twenty-five or thirty batches an hour. Studies of fast operating mixers showed that the usual time required for charging is 10 seconds and for discharging approximately 10 seconds, and therefore, that the number of batches might be increased from twenty-five to forty batches per hour, provided there was no lost time incident to the unloading of the mixer. The reduction of output was usually aggravated by unsystematic organization of the crew. The mixer was loaded with wheelbarrows, the material was not piled on the sub-grade with any particular attention for minimum handling, and the mixer operator was not instructed in the rapid handling of the machine and in taking advantage of the possibility of starting to raise the loading skip before the material was entirely discharged from the drum.

It is not within the province of this article or, in fact, within the province of an equipment manufacturer, to discuss costs of doing work or relative costs with given equipment but only to discuss different types of equipment and their economical use. Each job brings up its own problems and must be laid out according to the type of plant used. In the past, however, there has been a tendency on the part of contractors to wait until they receive the job before they decided on the type of plant to purchase. The progressive contractor, however, has changed his point of view and is today purchasing equipment of a type which he feels will give him the best satisfaction and then bidding on jobs accordingly.

UNLOADING THE MIXER

Increased output demanded three things: first, that the crew be organized; second, that special loading equipment be used; and third, that a larger mixer take the place of the smaller ones in order that the time the material is held in the drum may become a small factor in controlling the day's output.

Economical organization of the crew is dependent, first, on the men themselves, second, on the reduction by time studies of the number of men, and third, on the replacement of men by machinery.

The first change in machine design looking to more rapid charging of the mixer was the widening of the charging skip to accommodate two wheelbarrows at one time. This proved a great help, but still it required wheelers and the output was dependent on the ability to keep the skip loaded. Replacement of men by machinery came with the manufacture of the belt conveyor loader. This consists of a steel frame 60 ft. long, running on traction wheels and operated by a 5 h.p. gasoline engine. Standardized boxes furnished with bottom dump doors insured proper quantity of aggregate per batch. On this frame a woven belt 22 in. long and traveling at the rate of 450 ft. per minute serves to carry the materials forward and place them in the loading skip. Wheelers are no longer required. The number of men in the organization is reduced by six or eight, depending on the size of the machine. No more is there a tendency for the crew to become disorganized, for each man has particular work to do to keep the cycle of operation functioning with clockwise regularity. The minute the charging skip touches the ground the material is dumped through the hoppers onto the belt and 20 seconds later the charging skip is again ready to be raised. In other words, the machine has become a pacemaker for the crew.

For some years there has been a tendency toward the use of the industrial railroad for hauling materials in the construction of highways. Among the earlier methods was the use of standard 2-ft. gauge cars dumping into a sideloading mixer. This, however, did not fit the requirements as, in the first place, the track was not always at the same relative elevation as the mixer and, in the second place, it was not possible, with the size of the machine, to get full capacity out of the industrial equipment. The batch box system was, therefore, developed and has the advantage of allowing the industrial railroad to be operated to full capacity. The mixer was equipped with a derrick in order that the box might be swung over the loading skip and there discharged.

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*From paper before the Ohio Engineering Society.

†Of the Koehing Machine Co

In the discussion of cars and track, consideration should be given, first, to the design, second, to the number of boxes to a car, third to the use of "V" shaped cars instead of boxes, fourth, to the use of bottom dump instead of tip-over boxes, and fifth, the necessity for quick-acting equipment in order that full capacity may be obtained from the mixer.

Road contractors have generally accepted the standard 2-ft. gauge cars manufactured by the industrial car manufacturers using frames without platforms and placing the boxes directly on the frame. For mixers holding 14 and 21 ft. of mixed material, the use of two boxes to the car has proven the most satisfactory, as this gives full capacity from the standard 1½-yd. industrial car.

For the larger mixer, 28-feet capacity, only one batch box should be used per car, as the strength of equipment and the weight of rail will carry one batch box satisfactorily, but not two.

The use of "V" shaped cars loaded to capacity, with one aggregate dumped directly onto the subgrade, the materials then being rehandled to the mixer by use of the mixer loader has many advantages. The system obviates the possibility of tie-up because of breakdown of a portion of the plant at the loading station, or of transportation equipment and allows good storage of material insuring the concrete crew to work with regularity. With the materials for the concrete placed on the sub-grade, the system is more elastic than is the one using the batch box. It is also probable that with a given machine more yardage will be placed by dumping aggregates on the sub-grade and rehandling than if the quantity placed is dependent on the ability of the contractor to keep a steady supply of material moving to the mixer with the batch box system. However, there is the additional cost of rehandling this material, which doubtless offsets any reduction in cost per yard due to increased profits. The batch box system has the added advantage that the total number of men in the crew is reduced.

Some mention should be made of the three types of batch boxes that have been used during the season. They may be divided according to their method of discharge into, 1st, tip-over boxes, 2d, side-dump boxes, and 3d, bottom-dump boxes. The tipover box design utilizes a "V" shaped car body or has a rectangular batch box with trunnion below the center of gravity of the load, to which the yoke attaches. In order that the cement may be measured in bulk the "V" shaped body has been divided into three parts by placing a sheet metal box of the proper shape and volume in such a position in the body that the compartments are found in which the volume of fine and coarse aggregate is measured at the same time. In other words, the body or box is divided into three distinct compartments, one holding cement, one sand and the other stone. Two objections have been offered to this type of box, first, that the cement compartment does not clear readily, and second, that the tipping of the box results in a back kick making it difficult to hold the box in place.

The side-discharge box has the advantage of throwing the material well to the front of the loading skip but has the disadvantage of slow discharge and tendency to kick back. There is no opportunity to separate the cement from the aggregate and unless the bottom slope of the box is considerable, the materials will not flow readily. The sloping of the bottom requires a larger box and also places the center of the load higher and to one side.

The consensus of opinion is that the bottom-dump box equipped with a separate cement compartment most satisfactorily fills the requirements both for the 14 and 21-ft. paver, where the boxes are dumped by hand, and for the 28-ft paver where they are dumped by power. With this type of box there is no back kick when the materials are discharged.

Some question has been raised as to the relative advantage of wood and steel boxes. The steel boxes are probably somewhat lighter and nicer to handle when they are new, but once they have become bent they are hard to straighten. The wood box, on the other hand, can be easily repaired, and in case of a wreck a few new boards and a carpenter will quickly have them in working condition.

The season's work has shown the great advantage of picking the boxes from the car with a derrick on the mixer, taking advantage of the vertical lift offered by picking them with a full line instead of obtaining the necessary rise by lifting the boom. The advantages of this method are first, it is not necesssary that the cars be spotted so carefully, as they can be brought to place by tightening the cable; second, the relative elevation of boxes and mixer is not a factor in the operation, as there is sufficient line to lower boxes 3 ft. below the elevation of the machine if desirable; third, the derrick is quick acting, there being no delays to the operation of the charging skip while waiting for the yoke to be hooked in place.

Consideration should be given to the use of motor trucks instead of industrial railroad and also the use of tractors and trailers. No general conclusion can be reached on the relative advantage of these two methods of handling materials without knowing the local conditions that exist on a particular job. Motor trucks are entirely out of their class in heavy mud. On the other hand, the industrial track must be ballasted in order that the trains may run with necessary speed. If motor trucks are used, it is necessary that delays in loading and unloading be reduced to a minimum, as with a rental of $35 a day even short delays are expensive.

A proposition is before Congress for the provision, in successive years, of a total sum of $350,000,000 for the reclamation of unused lands in the west and south.

City Planning Literature

READY REFERENCES FOR THE SHELF OF A CITY PLANNING COMMISSION

Selected by THEODORA KIMBALL, Librarian, Harvard School of Landscape Architecture Honorary Librarian, American City Planning Institute.

Note: The file of *Proceedings* of the National Conference on City Planning (1910-date) is a most valuable source of information on many topics. The separate papers are noted under subjects in *Selected Classified List of References on City Planning*, by Theodora Kimball, published by the Conference, (60 State St., Boston) 1915,—a bibliography of about 1,000 titles, covering the whole field. To supplement this, the Conference and American City Planning Institute are now planning for the publication of an up-to-date *Manual of References on City Planning,* to comprise largely American references of particular use to practitioners and students. To obtain a complete list of city planning reports for cities in the United States, three publications must be consulted: *"American City" Pamphlet No.* 124 (Tribune Bldg., New York City), covering to December, 1914; lists in *Landscape Architecture* (15 East 40th St., New York City), quarterly, January, 1918, and January, 1920, covering 1914 to date.

While there are many publications which would be advantageous for a city planning commission to have at hand, the following short list has been selected, after consultation with various members of the American City Planning Institute, as offering a good start on some of the most important lines of information, and as representative of current practice.

GENERAL

Lewis, Nelson P. The planning of the modern city. New York, J. Wiley & Sons, 1916. 423 pages. Illustrated. Plans. Price $3.50.

Lays especial emphasis on American facts and experience.

Nolen, John. New ideals in the planning of cities, towns, and villages. New York, American City Bureau, 1919. 138 pages. Illustrated. Price, paper, 50 cents; cloth, $1.00.

An introduction to the subject.

Nolen, John, *Editor.* City planning; a series of papers (by seventeen experts) presenting the essential elements of a city plan. New York, D. Appleton & Co., 1916. 447 pages. Illustrated. Plans. (National Municipal League Series.) Price, $2.00.

Robinson, Charles Mulford. City planning, with special reference to the planning of streets and lots. New York, G. P. Putnam's Sons, 1916. 344 pages. Illustrated. Plans. Price, $2.50.

Of especial importance in relation to the platting of residential districts.

Shurtleff, Flavel, and Frederick Law Olmsted. Carrying out the city plan; the practical application of American law in the execution of city plans. New York, Survey Associates, 1914. 349 pages. (Russell Sage Foundation Publications.) Price, $2.00.

Deals with administrative and financial as well as legal problems. Should be supplemented by papers and questionnaire results: The constitution and powers of a city planning authority, in Proceedings of the National Conference on City Planning, 1915, and by later facts given in Mr. Lewis's book mentioned above.

Zueblin, Charles. American municipal progress. New and revised edition. New York, The Macmillan Company, 1916. 522 pages. Illustrated. Price, $2.00.

A summary of civic improvement.

SPECIAL SUBJECTS

Bassett, Edward M. Zoning. Supplement to National Municipal Review (North American Building, Philadelphia), May, 1920. Vol. 9, No. 5, p. 311-341. Price, 25 cents.

References to opinions of the Courts given. Also contains Bibliography of zoning, prepared by T. Kimball. A propaganda bulletin on Zoning, compiled and published by the American Civic Association (Union Trust Building, Washington, D. C.), is now in press and will shortly be obtainable. It contains papers and addresses by Lawson Purdy, Edward M. Bassett, Herbert S. Swan, Harland Bartholomew, and Andrew Wright Crawford. The American City Bureau, New York, will issue in Fall, 1920, a Digest of Zoning Experience in the United States, prepared by Charles H. Cheney, Alfred Bettman, and Theodora Kimball.

Comey, Arthur Coleman. A schedule of civic surveys. May, 1916. 16 pages. (Massachusetts Homestead Commission, Bulletin No. 5.) Free.

Hubbard, Henry V. The size and distribution of playgrounds and similar recreation facilities in American cities. Boston, National Conference on City Planning, 1914. 23 pages. Price, 10 cents.

Reprinted from the 1914 Proceedings of the Conference.

Practical street construction: planning streets and designing and constructing the details of street surface, subsurface and supersurface structures. Reprinted from a series of articles which appeared in Municipal Journal during the year 1916. New York, Municipal Journal and Engineer, 1916. 248 pages. Illustrated. Plans. Price, $2.00.

Rochester (N. Y.) Bureau of City Planning. Rules and regulations relating to laying out, dedication and acceptance of streets, etc. Rochester, 1919. 10 pages. Free.

Platting regulations have also been issued in convenient form by Portland, Oregon, and Revere, Mass.

Solotaroff, William. Shade-trees in towns and cities; their selection, planting, and care as applied to the art of street decoration, their diseases and remedies; their municipal control and supervision. New York, John Wiley & Sons, copyright, 1911. 287 pages. Illustrated. Plans. Price, $3.00.

This book should be supplemented by Bulletin No. 816 of the United States Department of Agriculture; Street trees, by F. L. Mulford; and by a summary statement of the principles of public plantings, by John Nolen: Trees and other public plantings, in *Landscape Architecture*, quarterly, April, 1920.

United States. Bureau of Industrial Housing and Transportation. Report of the United States Housing Corporation. Vol. II. Houses, site planning, utilities. Washington, Government Printing Office. 524 pages plus 19 pages. Illustrated. Plans. Price $1.50.

The most comprehensive collection of American data on low-cost housing developments. First edition exhausted. To be reprinted.

Williams, Frank Backus. Akron and its planning law. Akron, Chamber of Commerce, 1919, 40 pages. To be reprinted at a nominal cost.

The most useful recent summary of the law in the United States relating to city planning. The author has in preparation a comprehensive work on American city planning law.

Concrete Block Vehicular Tunnel Investigated

Summary of reply by Chief Engineer of Tunnel Commissions to the Goethals report on the concrete block type of construction. Takes exception to assumptions, data, analysis, and estimate and renews former objections.

In reply to the April 2d report* by General George W. Goethals defending the concrete block type of construction for the Hudson River Vehicular Tunnel, C. M. Holland, chief engineer for the New York and New Jersey Tunnel Commission, has reported at length to the commission discussing the different points made by General Goethals and expressing strong opposition to and contradicting some of them. He maintains the stand taken in his original report of February 28 on the points in controversy, and makes specific statements regarding the mathematics and analysis of the problem, but does not give space there to computations or demonstrations.

We give here the conclusions, very slightly abstracted.

Summarizing:

(1) General Goethals abandons his first plan for a tunnel and substitutes in this connection a plan for twin tubes.

(2) He further proposes a method for the receipt of bids which is entirely impracticable and impossible.

(3) He changes his plan of width of roadway, but adheres to the type of construction previously proposed, namely, concrete blocks.

(4) No detail estimate is given on which judgment can be based or the results determined as to how twin tubes of 38 feet 6 inches diameter can be built at a cost less than two twin tubes of 29 feet in diameter.

(5) General Goethals in the tunnel proposed, still adheres to what is claimed to be a three-line width of roadway, but this is modified by his own statement that, under certain conditions, there would be but two lines of travel.

(6) General Goethals' analyses are based on false assumptions, and his conclusions are worthless.

(7) Altogether, the letter in question, while it changes, as has been shown, the type of tunnel recommended and therefore is an abondonment of all that has been previously recommended by General Goethals, contains the same method of drawing conclusions, not from work which has been done, but basing statements of fact on assertions made by a contractor. * * * Attention is still called to the fact that comparison can not be made between a carefully worked out plan based on the result of the experience derived from the actual building of tunnels, with irresponsible statements of an interested contractor striving for effect.

General Goethals, in conclusion, states that, "The paramount question still remains; will your Commissions, simply because fearful of attempting something which heretofore has not been tried out in its entirety, recommend the expenditure of 26 to 30 millions to create facilities for vehicular crossing of the North River, when 10 to 12 millions less than this amount will accomplish the desired end" * * *

The Chief Engineer and the Board of Consulting Engineers of your Commissions * * * feel that in difficult subaqueous tunnel construction and in solving problems of tunneling, their experience and judgment should be entitled at least to as much weight as those of an engineer who has had practically no experience of this nature or of a contractor who has his own purpose to serve, and in addition, it should be remembered that the responsibility for the successful outcome of the project primarily rests on the shoulders of your engineers.

On one side the Commissions have before them a carefully prepared plan and estimate, and on the other side, a statement from General Goethals which he confesses is based on assertions of cost given by a contractor for a method of construction which has never been used under conditions similar to those which are to be encountered in building a tunnel under the Hudson River. No basis has ever been submitted to the Commissions by which they could judge in any way of the adequacy of the figures which have been given. There can be no fact, no assurance, because the methods proposed are entirely unknown and have never been used under conditions governing the construction proposed, and are altogether in a field of conjecture and ouside of any definite experience in subaqueous tunnel construction; and the assertion that the proposed methods of construction would save 10 to 12 millions can be accepted, if it is desired, but a study of what has been submitted leads your engineers to maintain that, not only would 10 to 12 millions not be saved, but that whatever money was expended in this experiment would simply be wasted, and the whole undertaking would end in disaster.

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*Abstract published June 19, page 549.

Whitfield P. Pressinger

Whitfield P. Pressinger, New York, vice president, Chicago Pneumatic Tool Company, died June 10th as a result of complications following an operation. Mr. Pressinger was actively engaged in the pneumatic tool and allied machinery industry for many years. He was general manager of the Clayton Air Compressor Company for seven years and became widely known through numerous activities in the American Society of Mechanical Engineers and the Compressed Air Society. He was born in New York City in 1871.

Recent Legal Decisions

CONTRACT AGAINST COUNTY FOR ROAD WORK

A contract for roadwork between a county and road contractors was an indivisible contract, although it provided for estimates as the work progressed, and for the issuance of time warrants upon such estimates. The Texas Court of Civil Appeals holds, Cobb & Gregory v. Parker, 216 S. W. 214, that the contractors, by presenting a claim for the final and full amount due under the contract and obtaining action thereon by certain commissioners acting as the county court or attempting so to act, allowing a certain amount as balance due, settlement in full, and subsequently instituting and prosecuting to judgment a claim for this particular amount as the balance due under the contract, whether they had success in recovering that amount or not, made an election to claim such sum as the balance due under the contract in full, and they could not again sue to compel the county court to issue warrants applied for on certain estimates made as the work progressed.

MODIFICATION OF CONTRACT

(Minn.) Where plaintiff, a subcontractor for painting for $1,000 after part performance, was obliged to stop because work on the building was stopped without his fault, and was forced to file lien to protect his rights if work was not resumed, and did the last work during the busy season instead of the slack season, as originally intended, there was a sufficient consideration for the modification of the original contract price from $100 to $125.—W. K. Morrison Co. v. Slonzynski, 175 N. W. 992.

(Mont.) A written contract supersedes all oral stipulations of the parties.—Helena Light & Ry. Co. v. Northern Pac. Ry. Co., 186 P. 702.

(N. C.) Where a contract is written, all previous negotiations of the parties are conclusively presumed to have been merged in the contract.—Patton v. Sinclaire Lumber Co., 101 S. E. 613.

(Tex. Civ. App.) In subcontractor's action against road contractor for damages for inability to perform contract because of failure of contractor to furnish gravel, question of whether contractor orally agreed with subcontractor to furnish and have on hand sufficient gravel wherewith subcontractor was to do work *held* for jury.—Hartwell v. Fridner, 217 S. W. 231.

QUESTION OF TRANSFER OF TITLE OF SUBCONTRACTOR'S MATERIAL

A written contract was made between a board of education and a contractor for the erection of a school building. The contract contained a covenant that if the contractor defaulted the board could enter and take all materials on the ground and use them in the completion of the building. The contractor sublet a part of the work to another, who shipped the material he expected to use, to his own order to be delivered on the premises; and it was delivered. Before the subcontractor used the materials the original contractor defaulted, and the school board took possession of the subcontractor's materials and used them to complete the original contract. The only evidence of transfer of title to the contractor was the delivery of the materials on the ground in the manner above set out, and the fact that the subcontractor had charged on his books of account the amount of the entire contract price to the contractor. In an action by the subcontractor's assignee against the school board to recover for the materials so taken and used, the New Jersey Court of Errors and Appeals holds, Jacobi v. Board of Education of Morristown, 109 Atl. 345, that these facts did not permit an inference that the subcontractor had passed the title of his materials to the contractor so as to subject them to the terms of the principal contract. The plaintiff was therefore entitled to a direction of verdict as the case then stood, and it was error to submit the question of title to the jury.

RIGHTS OF LABORERS AND MATERIALMEN UNDER CONTRACTOR'S BOND

The surety on a state contractor's bond for the performance of a building contract, which takes an assignment of all moneys payable on the contract, containing a stipulation that sums due thereon might be retained and applied to claims for labor and materials, can claim nothing by the assignment which is inconsistent with its obligation under the bond. Where, therefore, it assumes the contract and completes it at a loss, the laborers and materialmen have an equitable right to payment of claims for labor performed and material furnished prior to the contractor's default, out of funds retained, superior to the surety's right. U. S. Fidelity, etc., Co. v. Marathon Lumber Co., Mississippi Supreme Court, 81 So. 492.

PROTECTION OF LIEN CLAIMANTS UNDER PUBLIC IMPROVEMENT CONTRACTS

An Indiana statute of 1914 requires public officers and boards contracting for public improvements to withhold full payment until subcontractors or laborers have been paid, and requires such claims to be filed within thirty days after the completion of the work. The Indiana Appellate Court holds, State v. Puckett, 123 U. E. 650, that this statute confers no right of action on any one unless the public officer wrongfully fails to withhold money due the contractor which should have been applied to claims previously filed. Therefore a complaint in an action by the sureties of a public contractor against a township trustee to recover for an alleged wrongful payment by the trustee to the general contractor before the claims of subcontractors and laborers were paid was not sufficient to show a violation of the statute where it failed to allege the filing of such claims prior to the time of full payment; it being presumed that the trustee performed his statutory duties and that no claims had been filed.

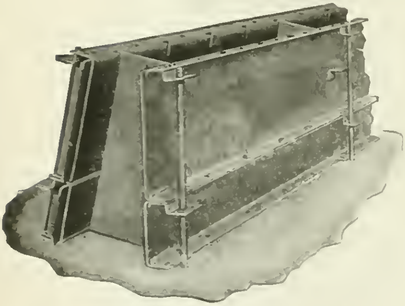
New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

BLAW FORMS FOR CONCRETE CURBS

Forms for deep concrete curbs are made by building up two tiers of single forms with their adjacent flanges bolted together and the successive sections connected by slip joints, thus providing for any required height and length.

The form plates are held in position by vertical steel stakes driven through lugs to penetration in the ground. If the curb is very high, and particularly if it is battered on one face, it is necessary to supplement the stakes by the use of temporary collapsible dividing plates which are set transversely to the side plates and space the latter exactly until the concrete is filled in between them, after which they are easily removed.



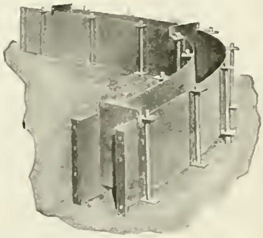
UNIVERSAL FORM FOR 18-INCH BATTERED CURB

The dividing plates, 3/16 inch thick, have shoulders at the upper ends that tengage slots in the form plates, locking them in position. They do not project above the top flanges of the forms, thus avoiding interference with any apparatus that may use the forms for track rails.

The dividing plates are of the required thickness to provide clearance at expansion joints where they are not removed until after the concrete has received its initial set. For positions intermediate between expansion joints, they may be removed before the concrete is set, permitting the concrete to fill the space occupied by the plates and make a monolithic structure without jointing there. For battered curbs, there has been developed a collapsible dividing plate which can be removed without removing either of the side form plates.

The curbs at the corners of street intersections can be most advantageously made with Blaw Flexible Forms that are fabricated from single pieces of special steel and will always spring back to the flat position when released. They are held securely in position by stakes not more than 18 inches apart and by dividing plates with slotted shoulders at the top as shown in the illustration, that hold them securely in position.

Where a constant repetition of the same radius occurs, Blaw Radius Forms are recommended. These have a channel shape cross-section made with thin steel web and light curved flange angles riveted to the outside faces, making them resemble somewhat the light fascia girders for structural steel work. These are very accurate and rigid and are easily handled. They are used like the flexible forms excepting that the stakes pass through holes drilled in the top and bottom flange angles and therefore do not require special lugs to receive them. Radius forms are made in standard lengths of 28 inches to 189 inches with corresponding radii of 18 inches to 120 inches.



FLEXIBLE FORM FOR CURB CORNER.

DAVIS NO. 1 BLASTER

The Davis No. 1 Blaster made by the Atlas Powder Company is a small 3¼-pound machine that develops ample current to fire five 35-foot copper wire electric blasting caps connected in single series.

The machine is encased in a nickel plated seamless brass tube with aluminum top and bottom plates and a leather strap for carrying. The leader wires being attached to the binding posts, the machine is held in the left hand and the key, held in the right hand, is inserted in the slot in the bottom and quickly twisted as far as possible to the right, thus firing the charge from a safe distance and with certainty and rapidity.

USING DAVIS No. 1 BLASTER

SHAPE AND BAR BENDING MACHINE

The Wallace Supplies Manufacturing Co. has put on the market the Wallace No. 5-A Angle Bender, for bending angles, channels, tees, rounds, square, square twisted, special sections and flat bars on edge, which weighs 1200 pounds. Angles can be bent with the web of angle on either the inside or the outside of the circle. A U-shape clamping plate holds angles to follower bar and prevents distortion of the angle iron. This clamp can be quickly applied and removed without loss of time.

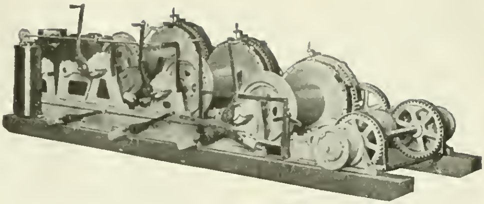
A follower bar operates between the rollers and the material and is machined to suit the section of the material.

The roller bracket for follower bar is adjustable to and from the center with a range to admit of the use of forms as large as 50 inches diameter. Machines with even greater adjustment can be furnished when required.

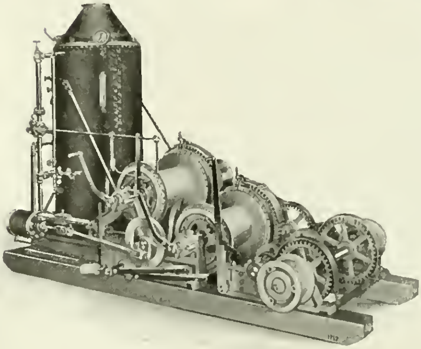
The machine is operated by a lever engaging the friction clutch pulley for forward and reverse and is equipped with adjustable stops to automatically disengage the clutch when the bend is completed; also, to disengage clutch from reverse when rollers have returned to the starting position. The stops are adjustable to cuit and degree of angle required.

The heads or forms are not standard, but are made to order on receipt of specifications The illustration shows machine equipped with dies suitable for bending angle iron, with the web of angle which is in the horizontal plane to be bent to the inside of the circle.

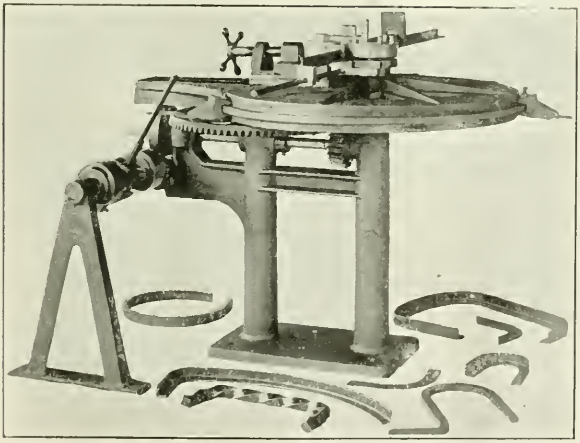
Samples of work bent up include channel 1½ x ¾ x ⅛-inch, bent cold, legs in, to 18 inch diameter, 320 degrees Angle, 1½ x 1½ x ¼-inch, bent cold, leg in, 3½-inch radius, 90 degrees and 20-inch radius 45 degrees. Square twisted steel reinforcement bar, 1¼-inch diameter, bent cold, 2-inch radius, 90 degrees. Flat steel, 1⅛ x ¾-inch bent cold on edge, 1-inch radius to 90 degrees and 8-inch centres, 180 degrees. Flat steel, 2 x ⅜-inch, bent cold on edge, 3-inch radius, 90 dedress. Angle, 1½ x 1½ x ¼-inch, bent cold, leg in, 7½-inch o. d., 180 degrees. Tee, mild steel, 1½ x 1½ x ¼-inch, bent cold, leg out, 3-inch radius, 90 degrees. Angle, 1½ x 1½ x ¼-inch bent cold, leg in, 3½-inch radius, 90 degrees and 20-inch radius 15 degrees.



ELECTRIC HOIST FOR OPERATING GRAB BUCKET



STEAM DERRICK HOIST, WITH DRUMS FOR SWINGING BULL WHEEL



MACHINE WITH SAMPLES OF SHAPES AND BARS BENT BY IT.

LIDGERWOOD EQUIPMENT

A very complete catalogue has just been issued by the Lidgerwood Mfg. Co., covering complete derricks of all types, derrick fittings for various types of wood derricks, and the various types of hoists, both steam, electric and oil engine driven, from the single-drum type of operating the derricks with booms of fixed radius, to the three-drum hoists with boom swinging gears for operating two-line grab buckets on derricks having a variable radius boom, and bull wheel for revolving.

Different types of lever arrangements are shown, both with the lever racks on the same bed with the hoists, and also showing the different methods of lever attachment for controlling the operation of the engine and derrick from a lever rack placed at a convenient point away from the hoist.

There is also a complete line both of hand power derricks and hand power hoists for same. A questionnaire is given covering all the information that is required to give complete specifications and estimates on any type of derrick and hoist that may be required.

The illustrations show two types of hoists which are standard for derrick work. The steam hoist is fitted to perform all the operations of ordinary derrick work, one drum being used for hoisting the load, the second drum for topping the boom, and the swinging drums rotate the bull wheel, swinging the derrick. All three operations can be performed simultaneously.

The electric hoist shown has, in addition, a third drum. This type of hoist is used for operating a two-line grab bucket, two drums operating the bucket, and the third raising and lowering the boom. Both these types are built with steam, electric or gas engine motive power.

INDUSTRIAL NOTES

ROAD MACHINERY BUILDING COMPANY ENLARGED

The Good Roads Company of Kansas City, Mo., manufacturers of high pressure atomizing road oilers, tar and asphalt spreaders, sprinklers, power flushers and other road building and maintenance machinery, was recently sold to the Good Roads Corporation, a new organization which will continue to manufacture the old line as well as other types of road machinery

All of the active members of the new corporation have had many years of experience in the manufacture and sale of such equipment Plans are now under way to enlarge the plants so that the production can be at least tripled Ever since the new corporation took over the business their two experienced engineers have been studying the equipment manufactured and have made some minor improvements.

The Good Roads Corporation is now in position to make immediate delivery of their combination high pressure atomizing road oiler, tar and asphalt spreaders and their high pressure road oilers.

AN $80,000,000 RAILROAD ORGANIZED IN CHILI

It is reported that in Santiago de Chile a corporation is being formed with a capital of $80,000,000 for the purpose of constructing a railway from Copiapo, already connected by railway with the Chilian port of Caldera, to Buenos Aires. It has also been announced that the Argentine Government has conceded to this concern ample facilities for making the necessary surveys and that the concession is at present under consideration. This railway will give a direct outlet to the Pacific for the agricultural and live stock products of the Northern provinces of Argentina.

NEW YORK ADMITS LIME TO CONCRETE

The Board of Standards and Appeals of New York City on April 19 adopted the following ruling:

"The use of hydrated lime in all classes of concrete construction shall not be prohibited when used in accordance with the condition hereinafter set forth.

"The hydrated lime shall conform with the following table, all weights given being the amount of lime which may be incorporated for each 95-pound bag of portland cement used:

"1-1½-3 mix: 4 pounds of hydrated lime per bag of cement.

"1-2-4 mix: 5 pounds of hydrated lime per bag of cement.

"1-1½-5 mix: 6 pounds of hydrated lime per bag of cement.

"For hand mixed concrete, the hydrated lime and portland cement shall be well mixed while dry.

"Hydrated lime shall not be used in concrete which is to be deposited under water."

UNUSUAL STEAM SHOVEL WORK

A seven-day test recently made on the operation of a 300-ton Bucyrus steam shovel, installed on the Queenstown-Chippewa power canal by the Hydro-Electric Power Commission of Canada, shows that in the seven days and two nights there were handled by it a total amount of 24,406½ yards of earth and rock at an expenditure of 0.826 k.w.h. of electricity per yard.

The shovel, which is said to be one of the largest in the world, has a 90-foot boom and an 8-yard bucket working on a 50-second cycle It is operated by two 250 h. p. electric motors for the hoist, one 150 h. p. motor for thrust, and one 150 h p. motor for swing, all of the Westinghouse 440-volt, 3-phase 25-cycle type.

The machine is operated by two men and at the time of the test was working 90 feet below the surface and loading material on cars 70 feet above its base.

In the operation of the shovel, the regenerated braking is utilized when the bucket is lowered 70 feet after delivering its contents to the cars. During the lowering of the bucket, the motors are connected to the power supply and operate as induction generators. Although this develops some energy, the principal advantage is in saving wear and tear on the brakes.

PERSONALS

Gregory, John H., has been appointed consulting engineer to the Bureau of Water Works Extension of Columbus, Ohio, which has been authorized to carry out improvements recommended by Mr. Gregory in a report submitted to the city last year. C. P. Hoover, who has been in the employ of thic ity for the past sixteen years, for the last ten in the Water Works Department, has been appointed engineer in charge.

Morden, E. B., has been appointed chief of the Bureau of Street Cleaning, Philadelphia.

Finebaum, H. J., formerly engineer, Shipyard Plants Division of the Emergency Fleet Corporation, Philadelphia, has accepted the position of assistant engineer to C. W. Hudson, consulting engineer, New York City.

Wilson, Clarence, has been appointed water superintendent of Montpelier, Idaho.

Verharen, A. W., has been appointed city engineer of Helena, Mont.

Pollock, James R., has been engaged by the city engineer's office, Flint, Mich., to investigate sewage disposal.

Olson, W. S., has been appointed office engineer of the commission of drainage and waters of Minnesota.

Guise, Philip, has been elected secretary of the Engineering Board for pier development, Jersey City.

Duck, J. A., is making a special drainage survey of the streets of Illinois.

Green, W. H., has been appointed project manager of the U. S. Reclamation Project at Huntley, Mont.

Wallace, Frank, has been appointed resident engineer of the U. S. Bureau of Public Roads at Missoula, Mont.

Patterson, J. R., has been appointed senior highway engineer, U. S. Bureau of Public Works, at Missoula, Mont.

Boustow, G. F., has been appointed location engineer of St. Louis County, Minnesota.

Meacham, J. C., has been appointed engineer of road construction, Marshall County, West Virginia.

Boutelle, G. J., has been elected city engineer of Chester, Pa.

Whipple, S. C., has been made assistant state engineer of California, with headquarters at Sacramento.

Baker, H. S., has been appointed county engineer of Spokane County, Washington.

Sanders, C. L. B., has been elected city engineer of Gainesville, Ga.

Robinson, D. O., superintendent of construction of the Hetch-Hetchy project in California, was recently killed by an accident on the work. He had been superintendent of construction of the Lower Otay Dam at San Diego, Cal.

Ackerman, J. W., has been appointed superintendent of the Water, Light & Power Department of Watertown, New York.

Kelsey, L. D., has been appointed city engineer of Raymond, Oregon.

Martin, Joseph A., has been appointed commissioner of public works for Detroit.

Richmond, W. S., has been appointed principal assistant engineer on the St. Lawrence River surveys.

Knittle, F. S., has been appointed city engineer of Casper, Wyoming.

Burkland, A. O., has been appointed engineer in charge of field surveys in Hawaii.

Fertig, J. H., has been appointed project engineer of the Grants Pass Irrigation District, Grants Pass, Oregon.

Pratt, A. H., has been appointed deputy engineer for the North Jersey District Water Supply Commission.

Prentice, Eugene, has been appointed special assistant city engineer, Binghamton, New York.

Holbrook, A. R., has been appointed extension, Columbus, Ohio.

Donnolly, C. E., has been appointed assistant city engineer, Kansas City, Mo.

Teeter, L. C., has been appointed engineer of Riley County, Kansas.

Hillman, Homer, has been appointed engineer of Sherman County, Kans.

Montgomery, Julian, has been appointed city engineer of Wichita Falls, Texas.

Brodie, J. A., has been elected president of the Institution of civil engineers, England. He has also recently been appointed consulting engineer to the government of India for planning of the new capitol at Delhi. He is also city engineer of Liverpool, England, with a staff of 4,000 men in charge of more than 500 miles of highways and streets and about 500 miles of sewers.

Dollard, E. C., has been appointed city engineer of Jamestown, N. Y.

Potter, J. G. B., has been appointed superintendent of public works at Jamestown, New York.

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